1.2

GROUNDWATER REMEDIAL ACTION PLAN
FOR THE
WESTPARK COMMERCIAL CENTER

BOISE, IDAHO

January 13, 1989

PREPARED FOR THE

WESTPARK PARTNERSHIP

BY

SPECIAL RESOURCE MANAGEMENT, INC.

SUMMARY

This report summarizes a remedial action plan to pump and treat contaminated groundwater at the proposed Westpark Commercial Center in Boise, Idaho. The contaminant of concern is a common industrial solvent - tetrachloroethene (also referred to as perchloroethylene, tetrachloroethylene, perc, or PCE). The highest concentrations of tetrachloroethene (1,000 ppb to 2,500 ppb) occur in the center of a narrow plume.

In March, 1988 the Westpark Partnership notified the Federal Environmental Protection Agency and the Idaho Department of Health and Welfare (IDHW) of the contamination. The partnership and Special Resource Management (SRM) have met numerous times with the agencies to discuss proposed sampling strategies and the conclusions of various project reports. In June, IDHW requested that further characterization of the contamination be conducted and this work was completed in October, 1988.

The Westpark Partnership proposes to remediate the identified contamination in the sand and gravel groundwater system to the forty foot level. Remediation will reduce contamination levels to 10 ppb. SRM and Westpark Partnership recognize, however, that the 10 ppb goal may be modified if the incremental cost of achieving 10 ppb is exorbitant or if the site target level is exceeded by higher upgradient background levels.

The objectives of the proposed remedial action at the Westpark site are:

- reduce the public's risk associated with PCE contamination in the sand-gravel groundwater system underlying the site to forty feet;

- satisfy public health agency concerns regarding contamination of the sand-gravel groundwater system under the Westpark properties;

- allow for a quick treatment system start-up;

- monitor the upgradient Westpark property to determine if PCE contamination is migrating onto the site from offsite; and

- allow for retail site development in conjunction with remediation.

Various treatment alternatives were evaluated against feasibility criteria and air stripping was determined to be the most practical system. It can attain PCE removal rates sufficient to maintain a 10 ppb discharge concentration. The system can be operated over a range of input flows and contaminant concentrations. Air stripping has been the selected alternative at numerous sites where volatile organic compounds are the groundwater contaminant of concern. The units can be purchased prefabricated and are readily available.

Three (3) eight-inch, forty-foot deep groundwater withdrawal wells will be installed in the center of the plume. A phased system startup will be utilized so that lower volumes of the higher contaminated water will be treated first. At full capacity the system will be pumping and treating 300 gallons per minute.

The treated water will either be discharged to the West Boise Sewer District or reinjected onsite through four (4) forty-foot deep or eight (8) eighteen-foot deep reinjection wells.

The selected treatment alternative is a proven technology and will meet the objective of removing PCE from the shallow sand/gravel groundwater system underlying Westpark. It's estimated that the Westpark groundwater should be reduced to approximately 10 ppb PCE in two to three years. Pumping Wells #1 and #2 could be turned off as early as 18 months. Pumping Well #3 will be the slowest to cleanup since an uncertain amount of contamination is west of Benjamin Lane.

Groundwater monitoring will be conducted during treatment and two years after the remediation is completed. Corrective action monitoring will indicate when treatment can be stopped. Assessment monitoring will be conducted after the cleanup to determine if the cleanup was complete and to determine if upgradient contamination is impacting the site.

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I. INTRODUCTION

This report summarizes a remedial action plan to pump and treat contaminated groundwater at the proposed Westpark Commercial Center in Boise, Idaho. The contaminant of concern is a common industrial solvent - tetrachloroethene (also referred to as perchloroethylene, tetrachloroethylene, perc, or PEC). The highest concentrations of tetrachloroethene (1,000 ppb to 2,500 ppb) occur in the center of a narrow plume migrating to northwest across a section of the property referred to as Parcel 1. This parcel is approximately 20 acres and will be developed as a retail shopping plaza.

A. SITE BACKGROUND AND LOCATION

On October 23, 1987, Pacific Rim Development Corporation retained the services of Special Resource Management, Inc. (SRM) to conduct a routine site investigation of 50 plus acres of Westpark property in Boise, Idaho. Along with the collection of basic soil engineering data, the site investigation was intended to provide sufficient data to document the presence or absence of any hazardous materials on-site. As part of the investigation, a series of soil and groundwater samples were collected for laboratory analysis. Analysis of one of the well water samples suggested the possible presence of tetrachloroethene. The contaminated well was resampled and tetrachloroethene was confirmed in the water. This first assessment at Westpark was completed on November 6, 1987 (ref. 1). Figure I.1 shows the general location of the Westpark site in West Boise, Idaho. Figure I.2 shows Parcel #1, and the adjacent property, and the monitoring well locations.

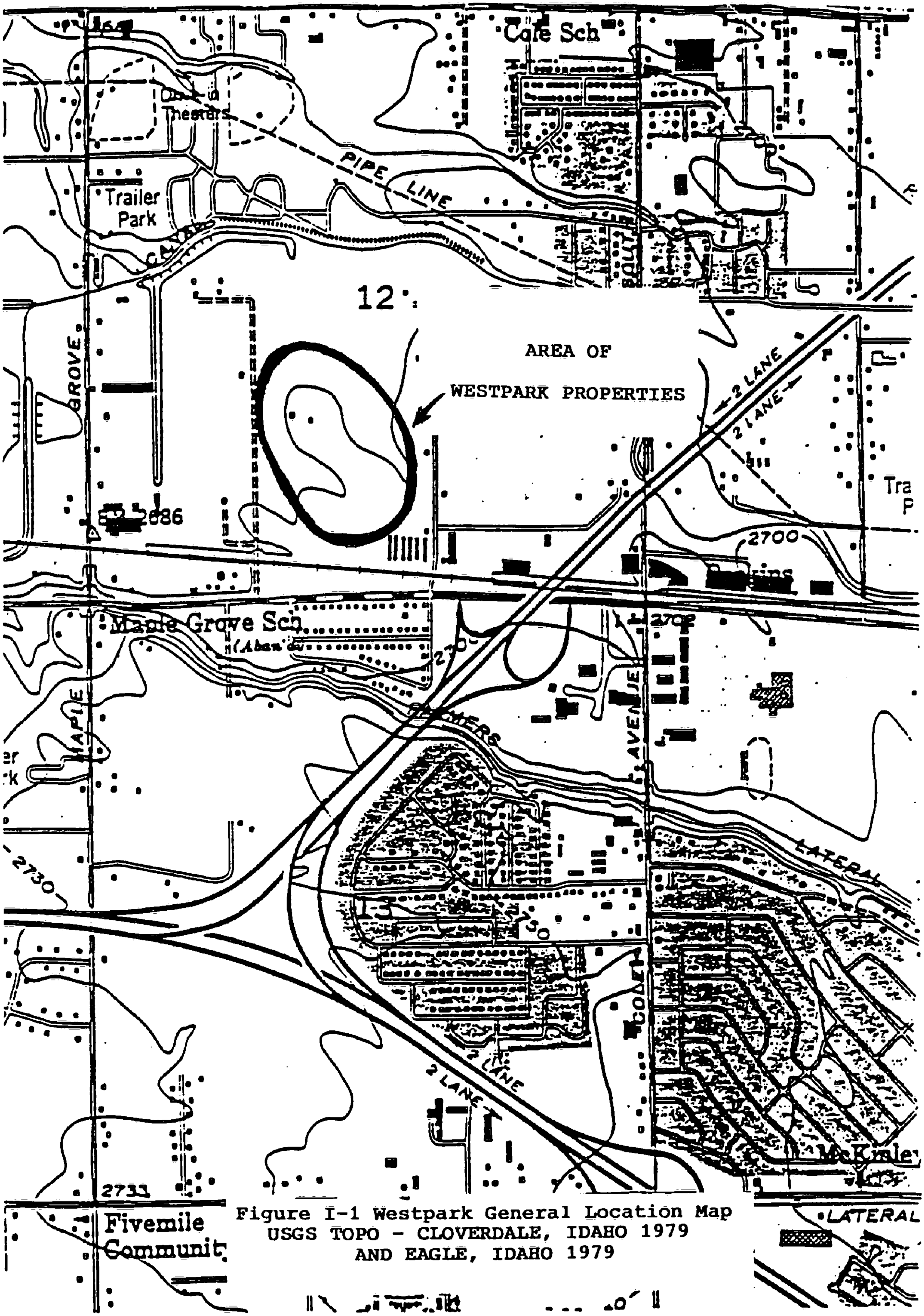


Figure I-1 Westpark General Location Map
USGS TOPO - CLOVERDALE, IDAHO 1979
AND EAGLE, IDAHO 1979

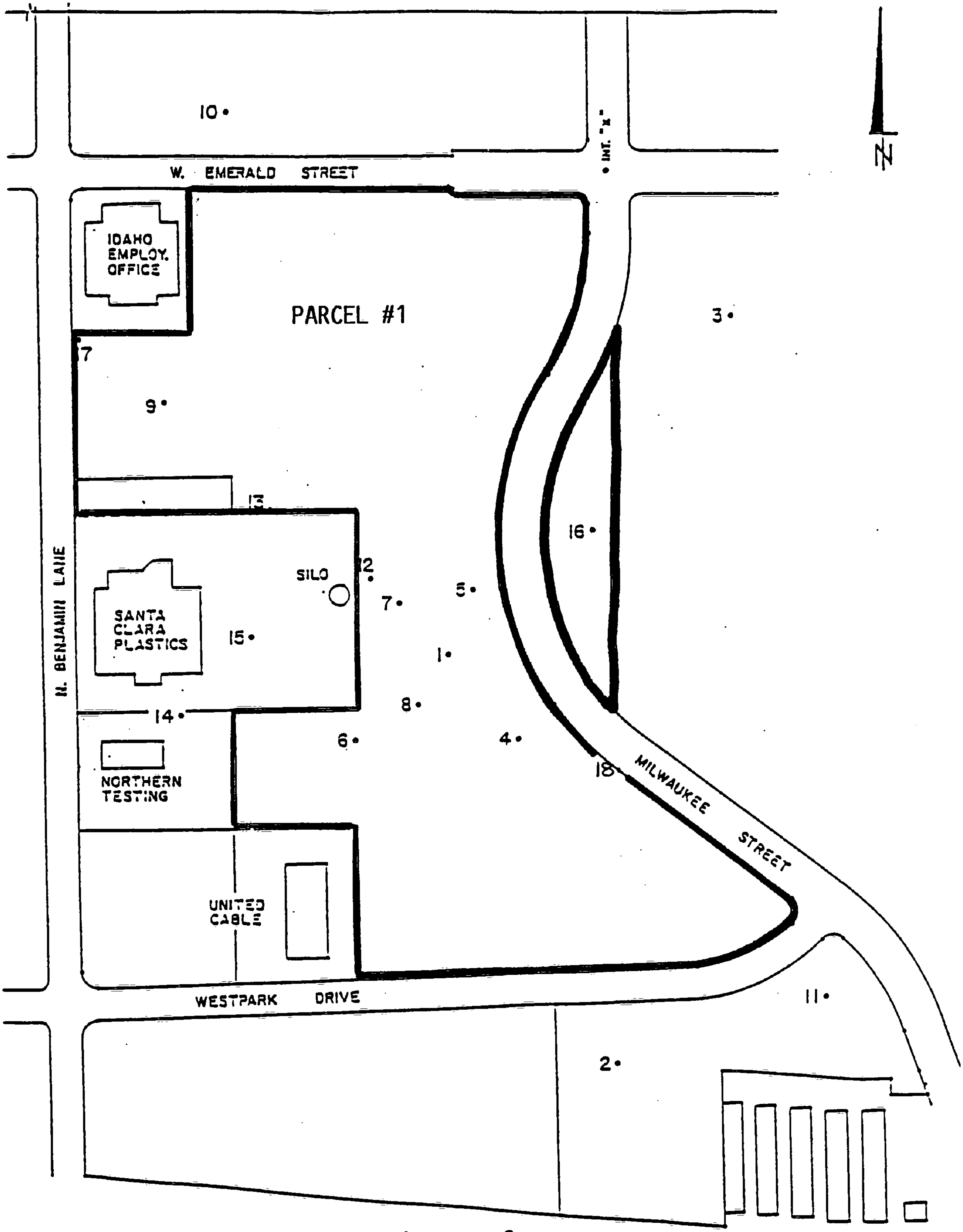


Figure I-2
Westpark Parcel #1 and Monitoring Well Locations

Further assessment of the contamination was requested and additional monitoring wells were installed on the Westpark properties and additional soil samples were collected. The second assessment was conducted from December 1987 through March 1988.

B. NATURE AND EXTENT OF CONTAMINATION

The second assessment was completed in March 1988. The results indicated that tetrachloroethene was present at levels greater than 10 ppb in the groundwater of Parcel #1. The groundwater flow within Parcel 1 has been determined to be northwest. The origin or source of contamination has not been identified. The highest concentrations in the center of the plume range from 1,000 ppb to 2,500 ppb. Low concentrations (3 ppb to 13 ppb) of trichloroethene have also been observed in the monitoring wells that have the highest concentrations of tetrachloroethene (1,000 ppb or more). Trichloroethene is one of the primary breakdown products of tetrachloroethene (reductive dehalogenation). The project report "Environmental Assessment II for the Proposed Westpark Commercial Center, Boise, Idaho", March 1988, (ref. 2) should be reviewed for sampling methodologies and results.

At the conclusion of the second assessment, the Westpark Partnership notified the Federal Environmental Protection Agency and the Idaho Department of Health and Welfare (IDHW) of the contamination. The partnership and SRM have met numerous times with the agencies to discuss proposed sampling strategies and the conclusions of various project reports. In June, IDHW requested that further characterization of the contamination be conducted.

Additional field work was conducted during the summer and completed on September 8. Surface and bore hole soil samples were collected on the upgradient end of the plume on July 14,

1988. The bore hole samples were collected at 0 to 1.5 feet, 2.5 to 4.0 feet and 4.5 to 6.0 feet. The sampling methods and results are discussed in detail in the third Westpark assessment report. Of the twenty soil samples collected, PCE was detected at extremely low concentrations near the detection limit of the laboratory in seven (7) samples. Two duplicate samples were analyzed and the results indicate that laboratory precision and accuracy at these low levels is marginal (i.e., for PCE the results were: sample B1.3 = <1.0 ppb, duplicate B1.3 = 1.0 ppb and sample B3.2 = <1.0 ppb, duplicate B3.2 = 3.4 ppb). None of the 45 plus soil samples collected during the three Westpark assessments indicate there is any significant surface (0 to 1.5 ft.) or near surface (1.5 to 6.0 ft.) soil PCE contamination. No further soil sampling is planned on the Westpark property.

During this summer's investigation, a set of groundwater samples collected on July 25, 1988 indicated that no PCE was detected in Well #12. Resampling was required and a laboratory quality control review is being conducted. The third assessment report serves as a companion document to the remedial plan and should be reviewed for the specifics of the June to September field work (ref. 3).

Westpark aquifer characteristics and plume migration are discussed in more detail in Section III. The Boise Valley aquifer system as a whole has been discussed at length in numerous other reports (ref. 4,5,6 & 7) and will not be discussed here. In general, the Westpark investigation has centered on the plume of PCE that is migrating across the site in the groundwater system. Eighteen monitoring wells have been installed on the Westpark or adjacent properties. Fourteen wells are seventeen feet deep or less. These wells are screened in the upper five to ten feet of the system. Four wells are thirty-two feet to 45 feet deep. Three of the deeper wells are screened within 20 to 40 ft. and one deep well is screened its entire length in the sand/gravel groundwater system (12 to 32 feet).

Well locations, depths and screen intervals were selected for a variety of reasons including source identification, upper and lower water sampling, future development plans, drilling equipment availability, development schedules, and property access.

The characterization completed for the Westpark properties suggests that PCE contamination occurs upgradient (SE) and downgradient (NW) of the site. The extent of the plume off-site can only be estimated since no off-site monitoring wells exist NW or SE of the site. However, the IDHW has tested private wells located downgradient from the site and found no PCE contamination in any of the wells. Resampling of the private wells is scheduled for early 1989.

The Westpark Partnership proposes to remediate the identified contamination in the sand and gravel groundwater system to the forty-foot level. Remediation will reduce contamination levels to 10 ppb.

C. OBJECTIVES OF REMEDIAL ACTIONS

The objectives of the proposed remedial action at the Westpark site are:

- reduce the public's risk associated with PCE contamination in the sand-gravel groundwater system underlying the site to forty feet;
- satisfy public health agency concerns regarding contamination of the sand-gravel groundwater system under the Westpark properties;
- allow for a quick treatment system start-up;
- monitor the upgradient Westpark property to determine if PCE contamination is migrating onto the site from offsite;
- allow for retail site development in conjunction with remediation.

Section II discusses the screening of remedial action technologies considered for the Westpark site. The preferred alternative is then developed in detail in Sections III through VII. It should be noted that the remedial action plan is designed so that groundwater treatment can continue over a range of conditions. The actual construction and operation of the treatment system will result in valuable site characterization information that will assist the Westpark Partnership in operating the system as efficiently as possible. With the plume migrating northwest at a rate of 2 to 4 feet per day it's desirable to initiate treatment as soon as possible.

II. SCREENING OF REMEDIAL ACTION ALTERNATIVES

This section presents a discussion of the remedial technologies that would reduce the Westpark groundwater (40 foot level) PCE concentrations to levels acceptable to public health authorities. The applicable technologies were evaluated with respect to the following criteria:

- technical feasibility (proven performance, reliability, schedule for operation);
- effectiveness to address public health concerns;
- cost;
- compatibility with retail development.

The groundwater treatment remedial action includes the tasks of 1) groundwater withdrawal, 2) treatment to remove contaminants, and 3) disposing of treated water. Disposing of the treated water is not of significant environment concern since the target cleanup level is drinking water quality. However, institutional concerns and an uncertain level of perceived risk must be addressed. The cost of disposing of the treated water is significant, therefore several options are still under review. The most economical and practical disposal method may be a combination of strategies during the period of treatment. Two options are presented for effluent water disposal in Section V.

A. REVIEW OF ALTERNATIVES AND FEASIBLE TECHNOLOGY

The action alternatives considered for the Westpark site were:

1) No action/monitoring only

2) Dilution by injection of clean water

3) Biological treatment

4) Activated carbon adsorption

5) Air stripping

6) Activated carbon with air stripping

The first two alternatives, no action and dilution with clean water, were found unacceptable. Alternative 3 was determined not to be technically feasible.

1. No Action/Monitoring Only

The feasibility of no remedial action at Westpark was assessed and is discussed below. To complete the assessment, it was necessary to make a number of assumptions regarding how public health authorities may view the no action alternative. Given the public's current perception of toxics in the environment, we have assumed that the public health authorities would require further investigation of the contamination before a no action alternative would even be considered. It's SRM's opinion that the agencies would require the Westpark Partnership to show that no public health concerns exist due to the tetrachloroethene contamination at the site. Completing a public health assessment of this type would require a substantial amount of new drilling, investigation time and laboratory analysis. The resulting conclusions of the risk assessment may be that groundwater remediation is needed at Westpark to protect public health. In addition, it would be difficult to assess the risk related to an unknown amount of contamination that apparently exists offsite. Installing a treatment system after site development is underway would be inefficient in terms of both cost and time.

2. Dilution Alternative

Dilution of the contaminated water by injection of clean water was investigated. An injection rate of about 300 to 400 gpm is about the maximum achievable which would not cause a potential rise in water level. Injection of clean water along the axis of the plume would result in mixing and displacement of contaminated groundwater. Four to five years of continuous pumping would be required to reduce the maximum concentration to a value of about 140 ppb. The calculated area of contamination would then be increased from 20 acres to over 100 acres. It was felt that this option would not satisfy public health officials and may increase the exposure potential to the public. Therefore, further assessment for this alternative was not conducted.

3. Biological Treatment

The feasibility of treating the plume with micro-organisms was briefly assessed. Two vendors of commercial biological treatment systems were contacted and interviewed. Currently there are no bacteria strains that are capable of rapidly breaking down tetrachloroethene. The molecule is too large to serve as a food source for the normal bacteria utilized for treatment. Several universities are conducting research related to the biological treatment of waste chlorinated solvents, but the results to date have not been promising.

4. Activated Carbon

Activated carbon used as an adsorption media for the PERC was investigated. In this design four carbon canisters, each weighing 2,000 pounds are split into two sets of two canisters. Half of the contaminated water would be pumped through each set of the two canisters. When the carbon is spent or unable to adsorb more PERC, it must be replaced. This contaminated carbon must either be regenerated or disposed of at an EPA approved site for RCRA hazardous waste. Regenerated carbon is recycled and then returned to the generator for reuse. When closing this operation down the four remaining canisters, contaminated with PEC, would be sent for regeneration and then sent to an approved landfill. Regeneration prior to landfilling is necessary to reduce the level of chlorine. The advantages of carbon adsorption are the low pressure drop through the canisters, the low cost of installation, and attainable PERC removal rates. Disadvantages include high transportation costs of the canisters, high capital cost of the canisters, high operating cost, potential clogging, and the generation of hazardous waste and the subsequent special handling requirements.

5. Air Stripping

The use of air as a stripping medium for the PCE was investigated. An air stripper approximately 25 feet high and 4 feet in diameter would be used. The contaminated water is pumped to the top of the packed stripper. A fan blows air up from the bottom through the water which flows downward and the PERC is removed from the water. The closing costs of this option are assumed to be offset by the scrap value of the equipment. The advantages of an air stripper are the low relative cost, operation flexibility, no solid hazardous waste generation, and attainable PERC removable rates. Disadvantages include release of low concentrations of PERC into the atmosphere, the more difficult installation of the equipment, additional power requirements (fan motor) and potential clogging.

6. Activated Carbon/Air Stripping

The combination of an air stripper followed by carbon adsorption was also investigated. A smaller, less efficient air stripper would be used followed by two canisters containing activated carbon. Closing costs consist of the disposal cost of the contaminated carbon canisters only. Advantages of this option include a smaller, less costly stripper, and attainable PCE removal rates. The disadvantages include higher overall cost, increased installation time due to installing two types of treatment hardware, and release of low concentrations of PCE into the atmosphere. The costs for a combination system were substantially higher than the air stripper alone.

B. RECOMMENDED REMEDIAL ACTION

The treatment alternatives were evaluated against the criteria discussed above and air stripping was determined to be the most practical system. It can attain PCE removal rates sufficient to maintain a 10 ppb discharge concentration. The system can be operated over a range of input flows and contaminant concentrations. Figure II-1 shows a schematic of a packed tower air stripper. Air stripping has been the selected alternative at numerous sites where volatile organic compounds are the groundwater contaminant of concern. The units can be purchased prefabricated and are readily available (ref. 8).

Three (3) eight inch forty-foot groundwater withdrawal wells will be installed in the center of the plume. A phased system startup will be utilized so that lower volumes of the higher contaminated water will be treated first. At full capacity the system will be pumping and treating 300 gallons per minute.

The treated water will either be discharged to the West Boise Sewer District or reinjected onsite through 4 - forty foot reinjection wells or 8 - eighteen foot wells.

The selected treatment alternative is a proven technology and will meet the objective of removing PCE from the sand/gravel groundwater system underlying Westpark to forty feet. It's estimated that the Westpark groundwater should be reduced to approximately 10 ppb PCE in two to three years.

The following Sections discuss the treatment system in more detail. The specific air stripper model has not been selected at this time. Detailed operating procedures and training requirements will be implemented when the specific unit is selected.

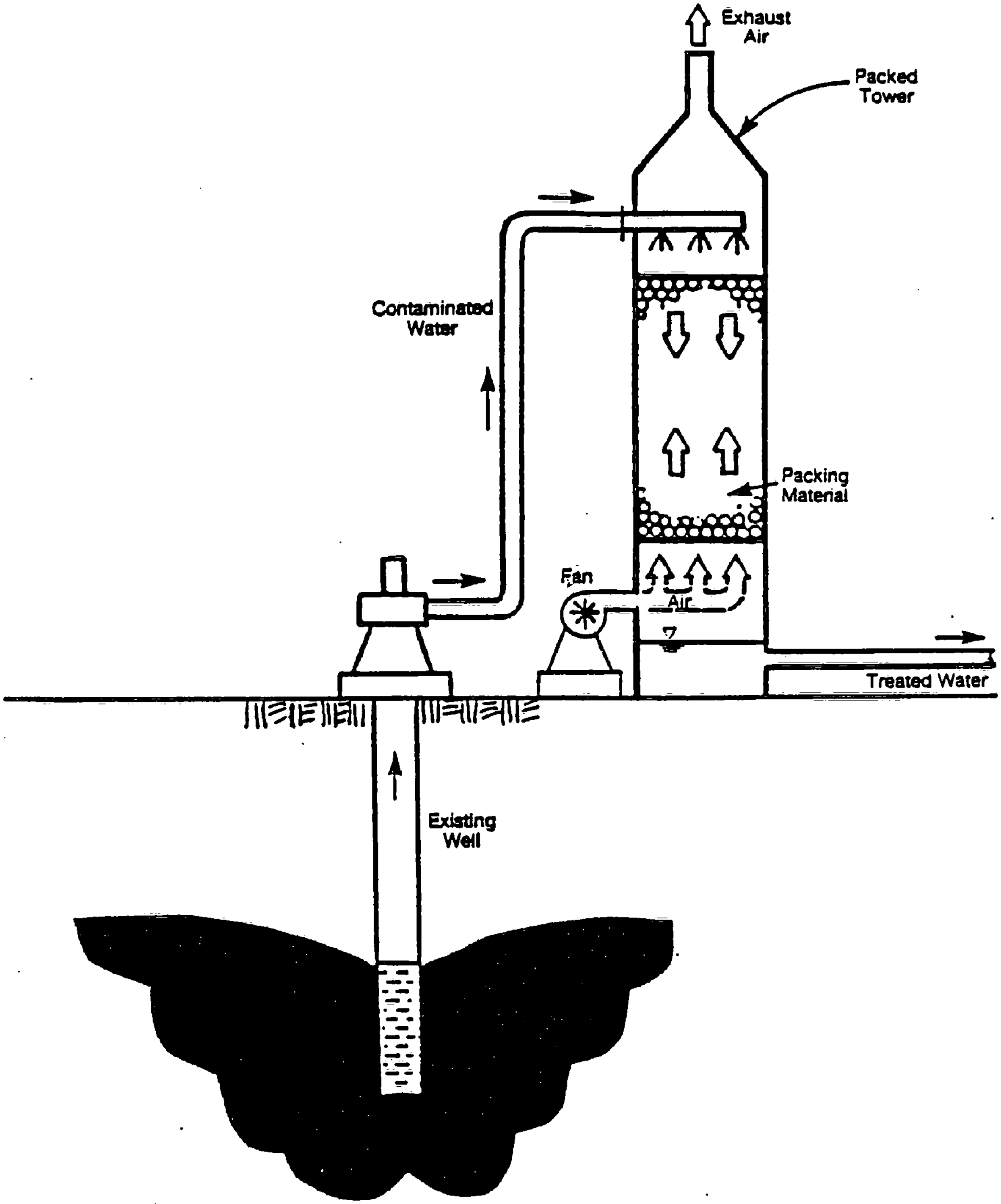


FIGURE II-1

GENERAL SCHEMATIC OF A

PACKED TOWER AIR STRIPPER

(source: reference 8)

III. CONTAMINATED GROUNDWATER WITHDRAWAL

A. AQUIFER CHARACTERIZATION

The Westpark Site is located on a gravel terrace often referred to as the Whitney Terrace. Water bearing formations under the site are informally divided into two groundwater systems; deep and shallow. The deep system is part of the Glenn's Ferry formation and is separated from the shallow system by clays or clayey sands. Lithology of the shallow system consists of sands,gravels, cobbles and boulders with occasional silty or clayey layers. Logs of some wells near the Westpark site indicate the presence of clay or fine sand at a depth of 45 to 50 feet. Logs of observation wells on the property suggest that sediments of the shallow system may become finer with depth. Permeability values for the deep system are reported to be lower than for the shallow system. Various investigations have reported well yields as high as 4,000 gallons per minute (GPM) and transmissivities as high as 230,000 gallons per day per foot (GPD/ft). Storativity values range from 0.004 to 0.23 (ref. 2,3,4 & 5).

Water levels measured on four different dates are plotted on Figures III-1 to 4. Hydrographs of observation Wells 1, 9, 11 and 17 are plotted on Figures III-5 to 8. The water table configuration and shape of the hydrographs are very uniform The water table maps and hydrographs suggest that the response of the shallow groundwater system to irrigation water is simply a uniform rise or fall which is consistent with the aquifer properties reported below.

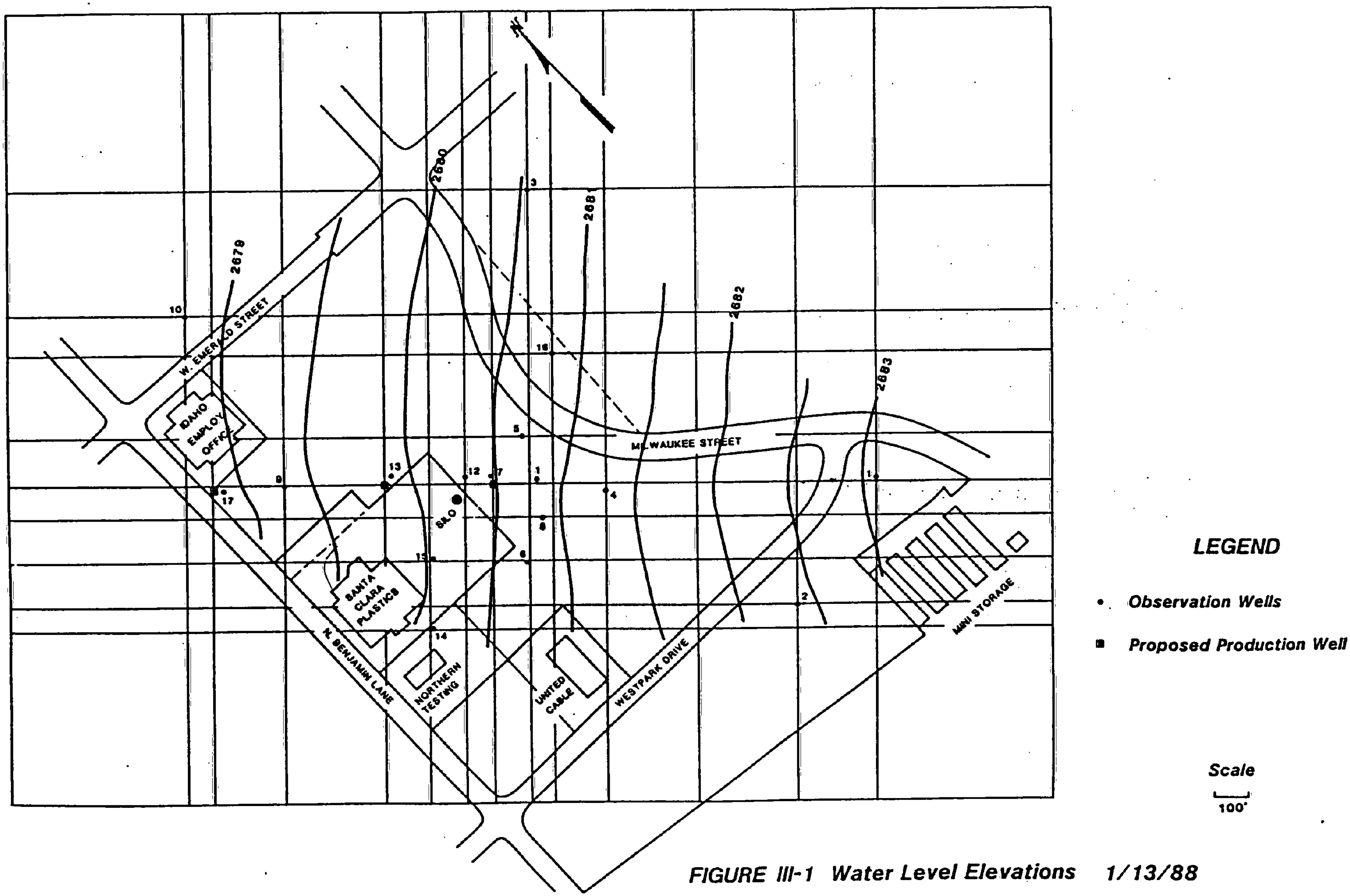
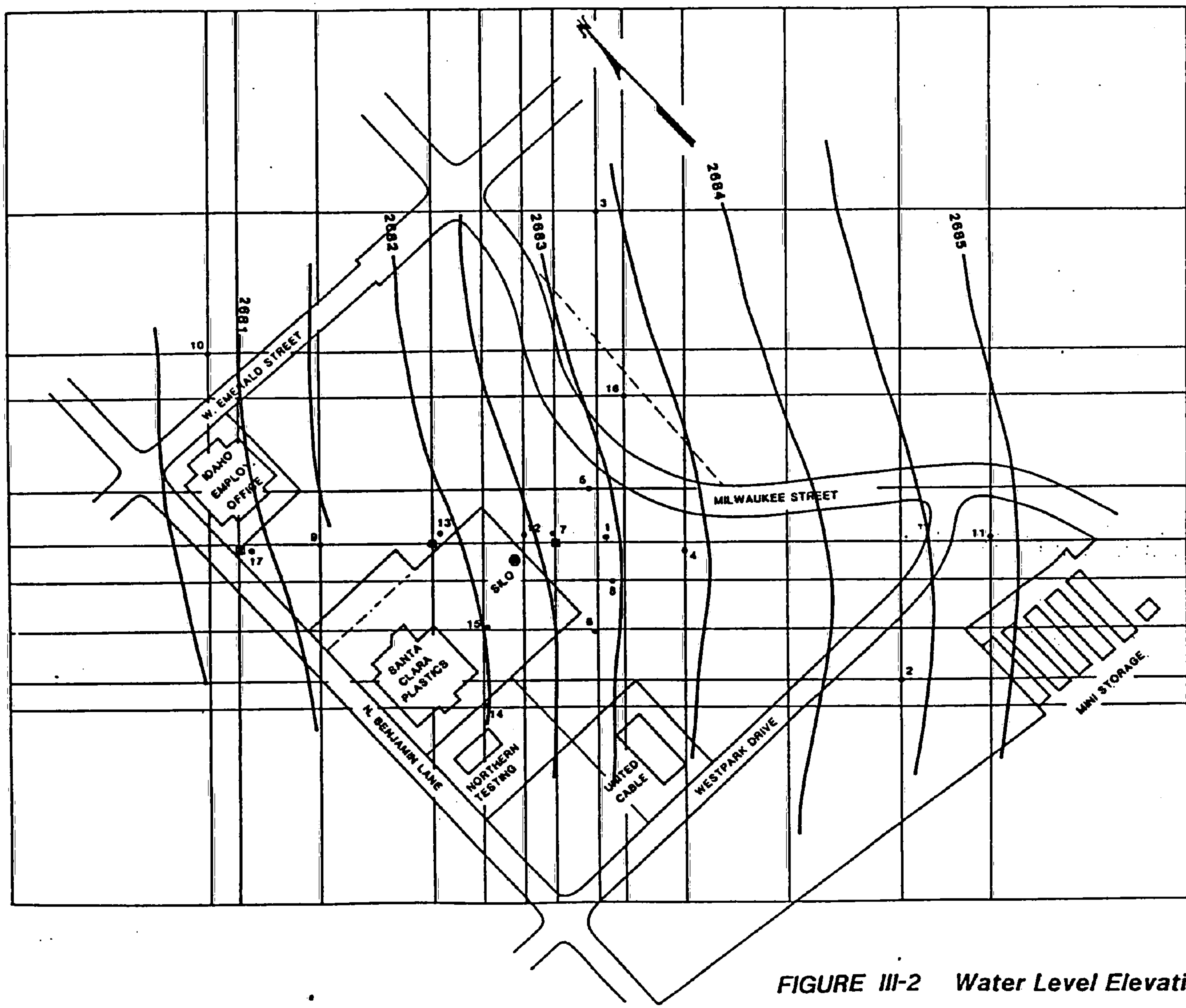


FIGURE III-1 Water Level Elevations 1/13/88



LEGEND

- Observation Wells
- Proposed Production Well

Scale

100'

FIGURE III-2 Water Level Elevations 7/07/88

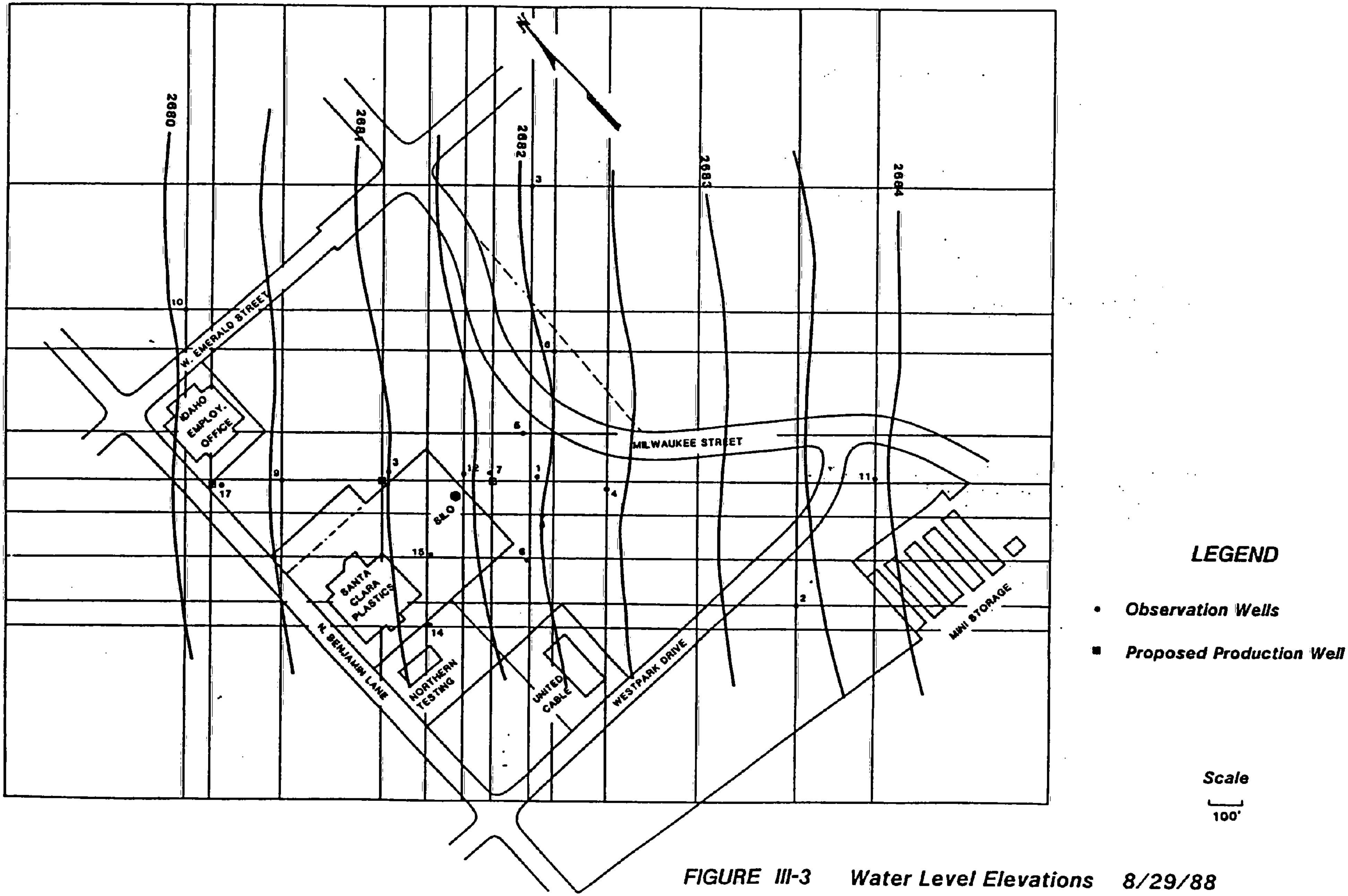


FIGURE III-3 Water Level Elevations 8/29/88

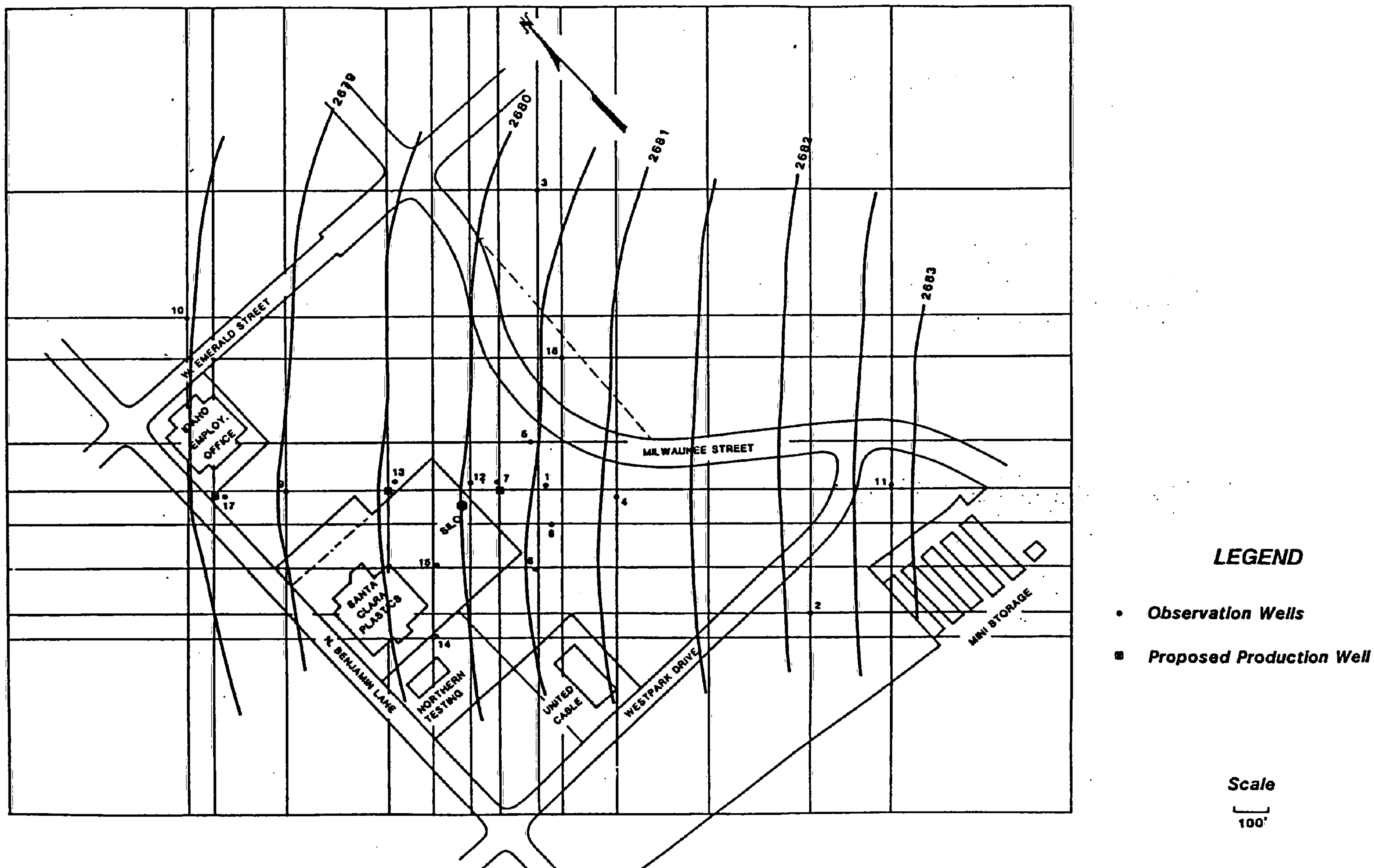


FIGURE III-4 Water Level Elevations 10/05/88

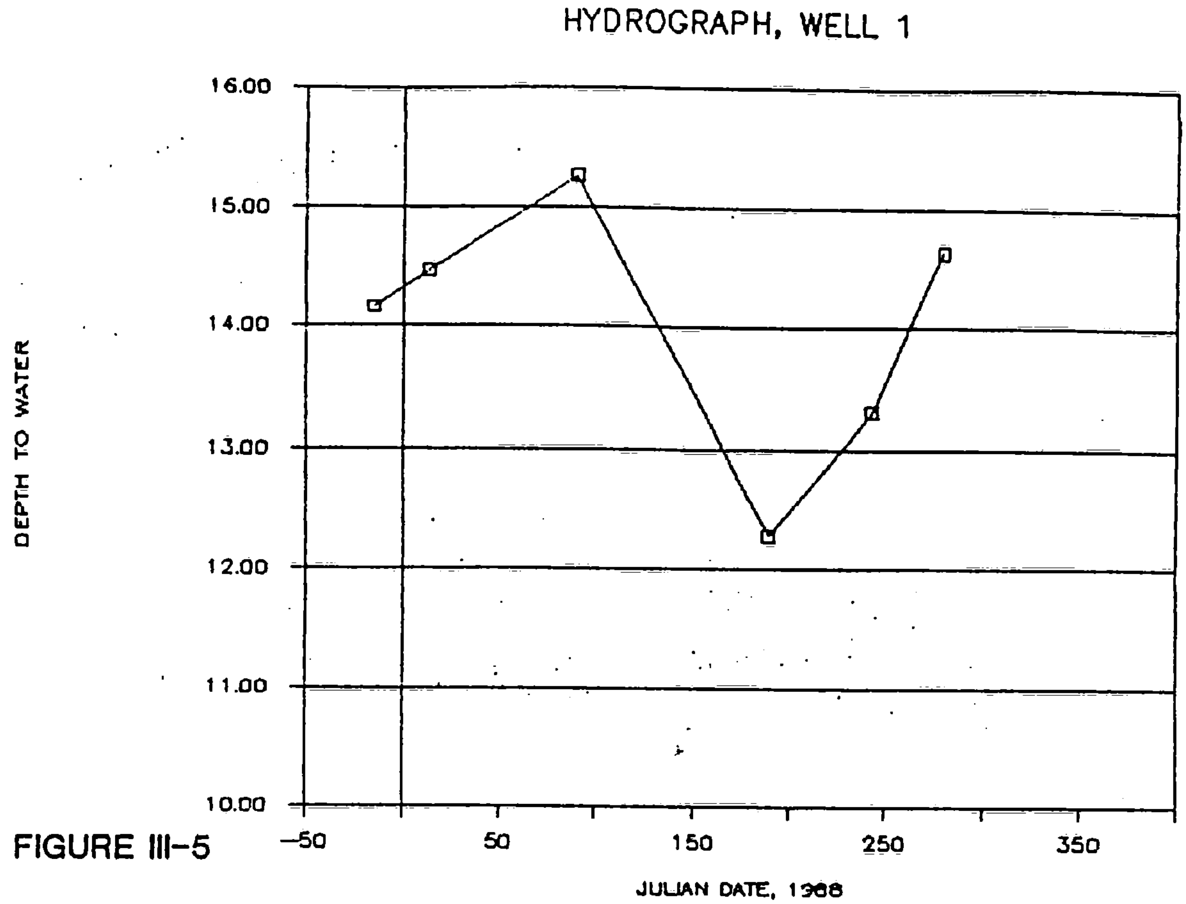


FIGURE III-5

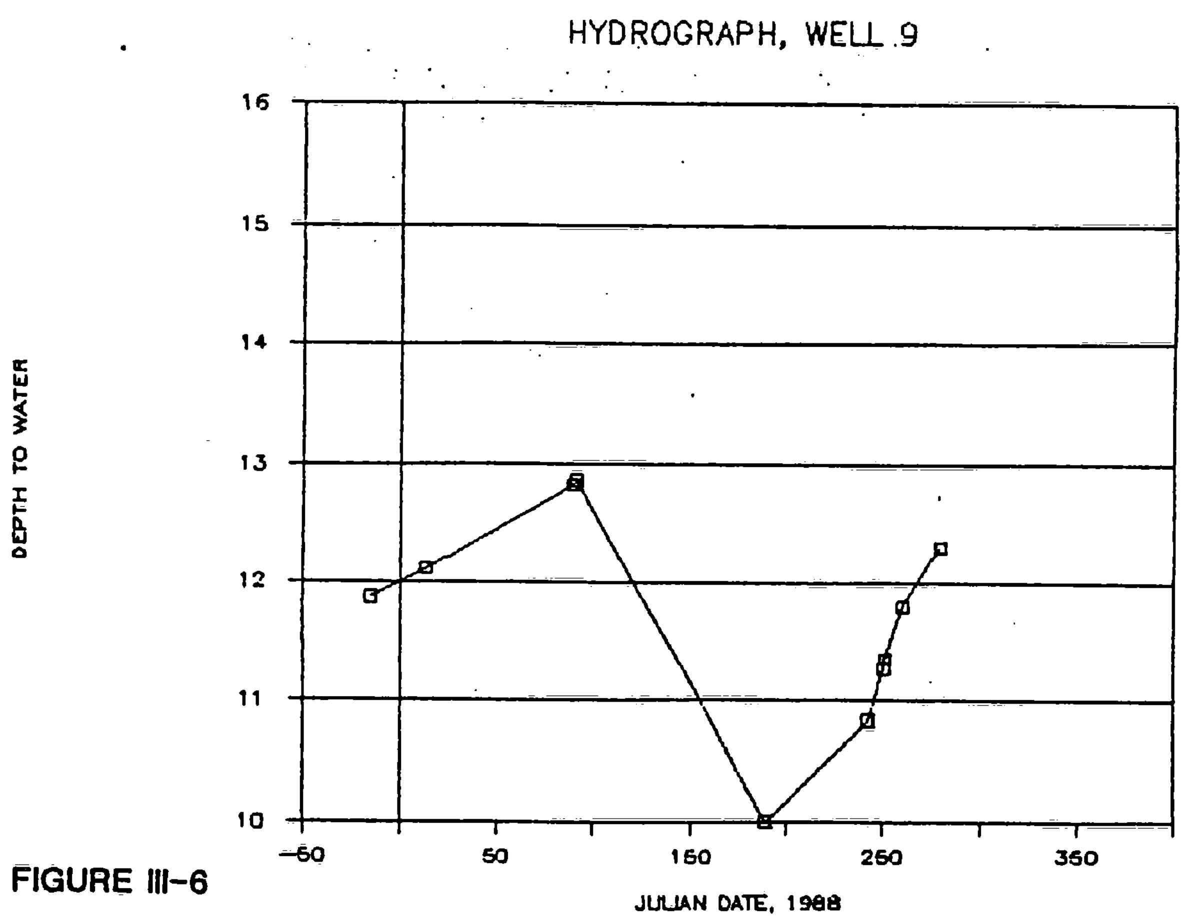


FIGURE III-6

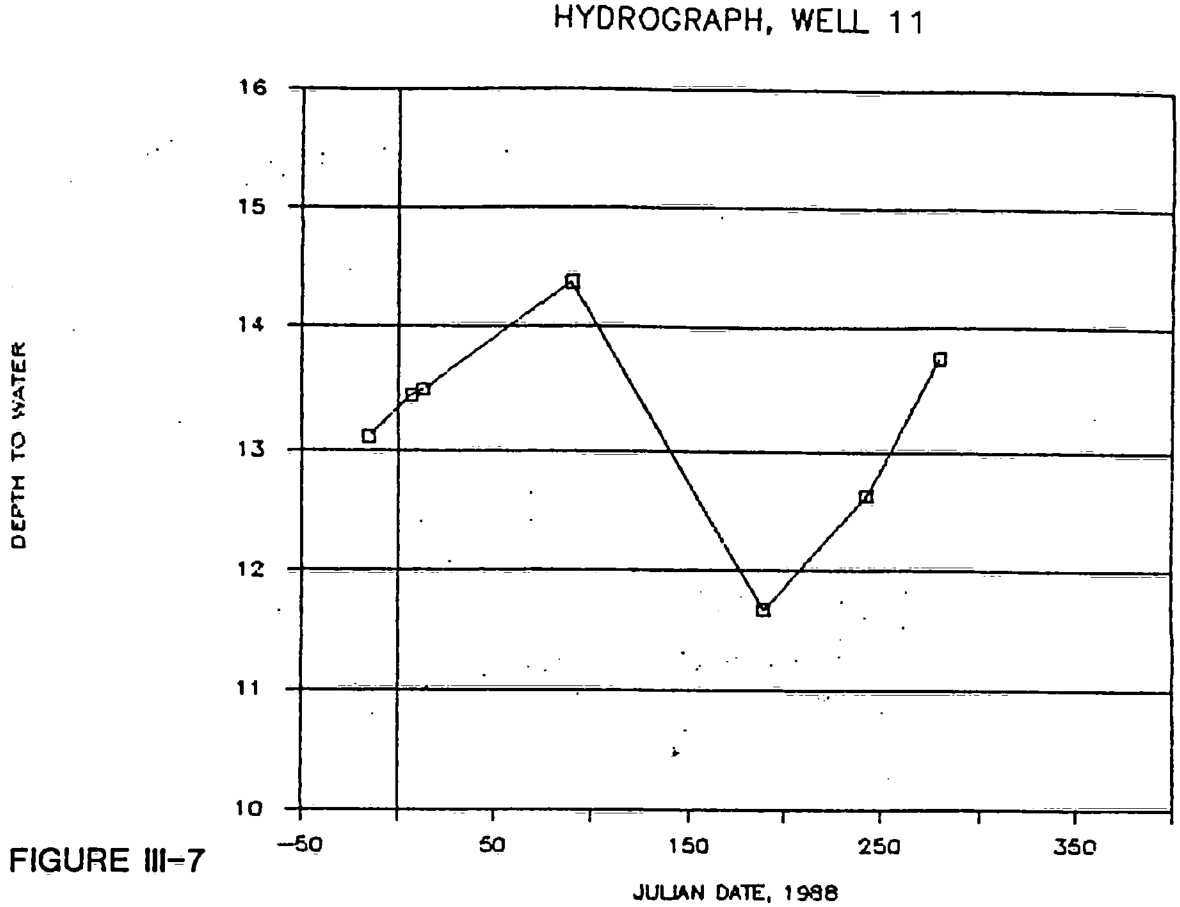


FIGURE III-7

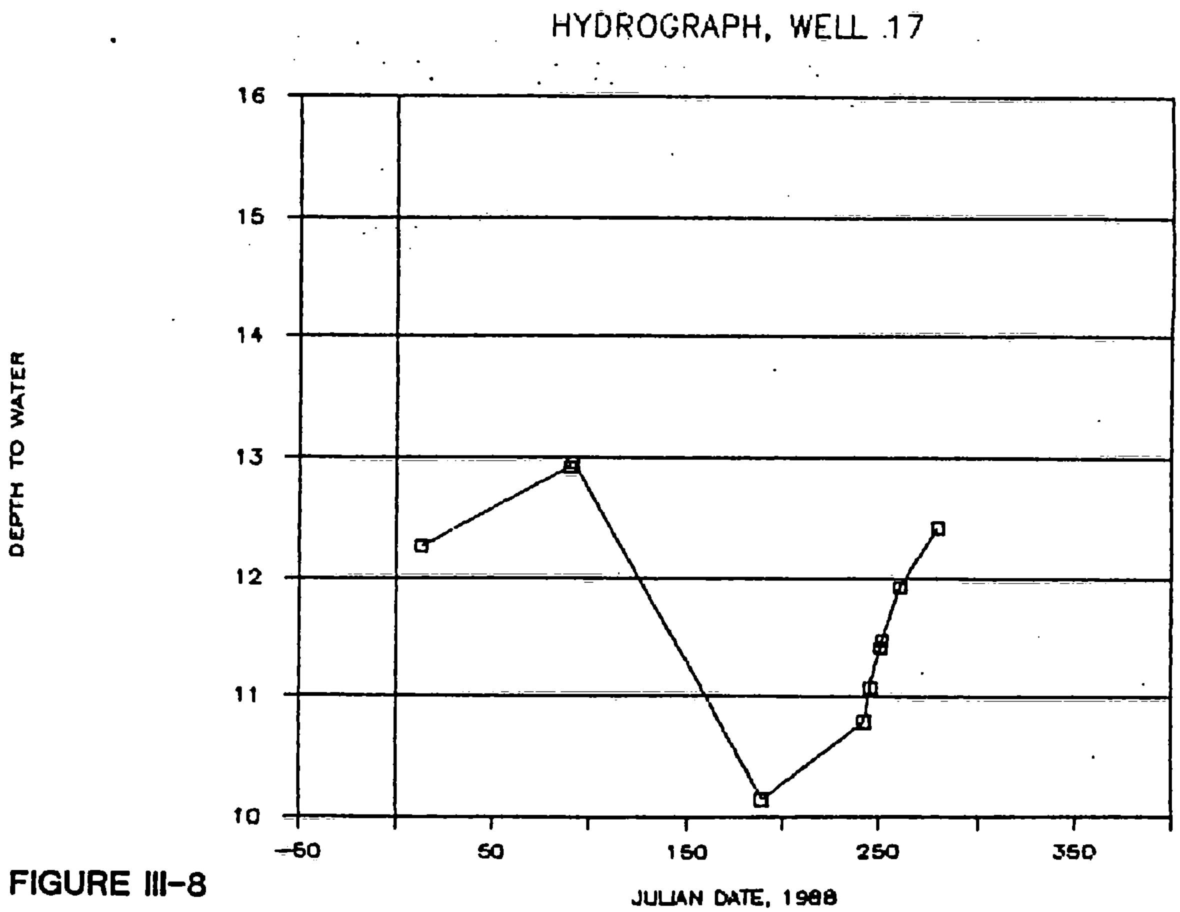
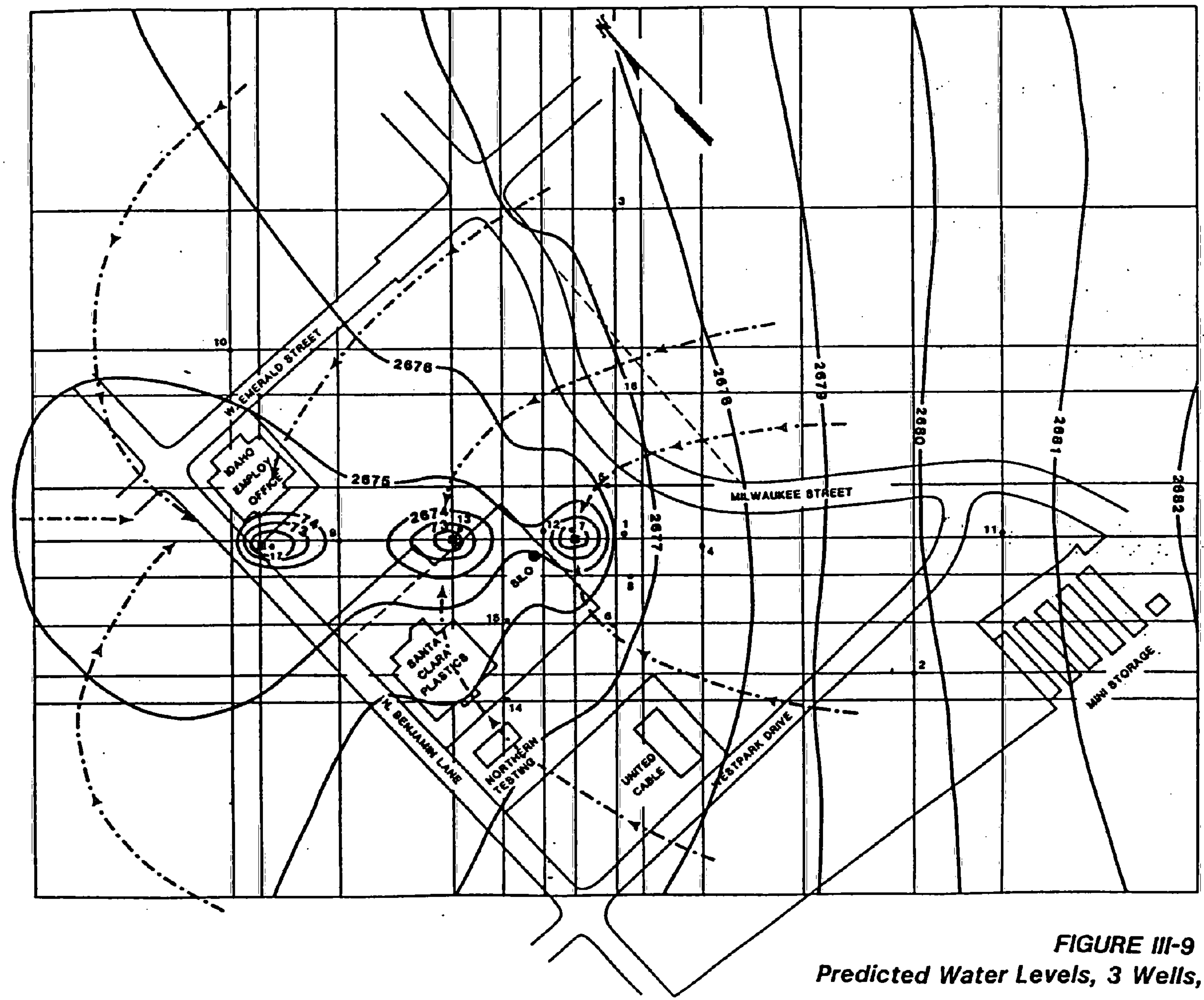


FIGURE III-8

Determination of aquifer properties for a gravel aquifer such as that underlying this site ideally involves extended pump tests (several hours) at rates which could stress the aquifer, in this case greater than about 25 gallons per minute (gpm). However, extended pump tests would necessitate the storage and disposal of relatively large volumes of water if wells in the plume were pumped well. If some of the uncontaminated wells were pumped for extended time periods, it could cause the plume to expand in the direction of the pumped well. Therefore, most tests to-date have been short term tests at rates under 15 gpm or slug tests. Well 9 was pumped at 5 gpm for 10 hours and then at rates of 7 gpm for 1 hour, 10 gpm for 1 hour and 15 gpm for 15 minutes.

Aquifer test results for Wells 8, 9, 10, 11, 12, and 17 are tabulated in Table III-I. Storativity was estimated to be 0.03 based on the 12 hour test in Well 9. These data were used in a computer model to predict drawdowns for various pumping well configurations and pumping rates as well as for predicting the effects of reinjecting water after treatment. For the modelling effort a grid shown in Figure III-9 was laid out such that all the observation wells fall very close to grid intersections or nodes. Drawdowns predicted by the model were used to prepare a water level map for 30 days of pumping assuming beginning water levels shown in Figure III-3.

Figure III-9a shows the water levels for a pumping and reinjection scenario where 8 - eighteen foot reinjection wells are used for effluent water disposal. Some mounding occurs during treatment and there will be a wider area of low level (<10 ppb) PCE in the Westpark area if reinjection is selected for effluent water disposal.



LEGEND

- Observation Wells
- Proposed Production Well
- Water Level Contours
- Flow Path

Scale

100'

FIGURE III-9

Predicted Water Levels, 3 Wells, 100 gpm, 30 Days

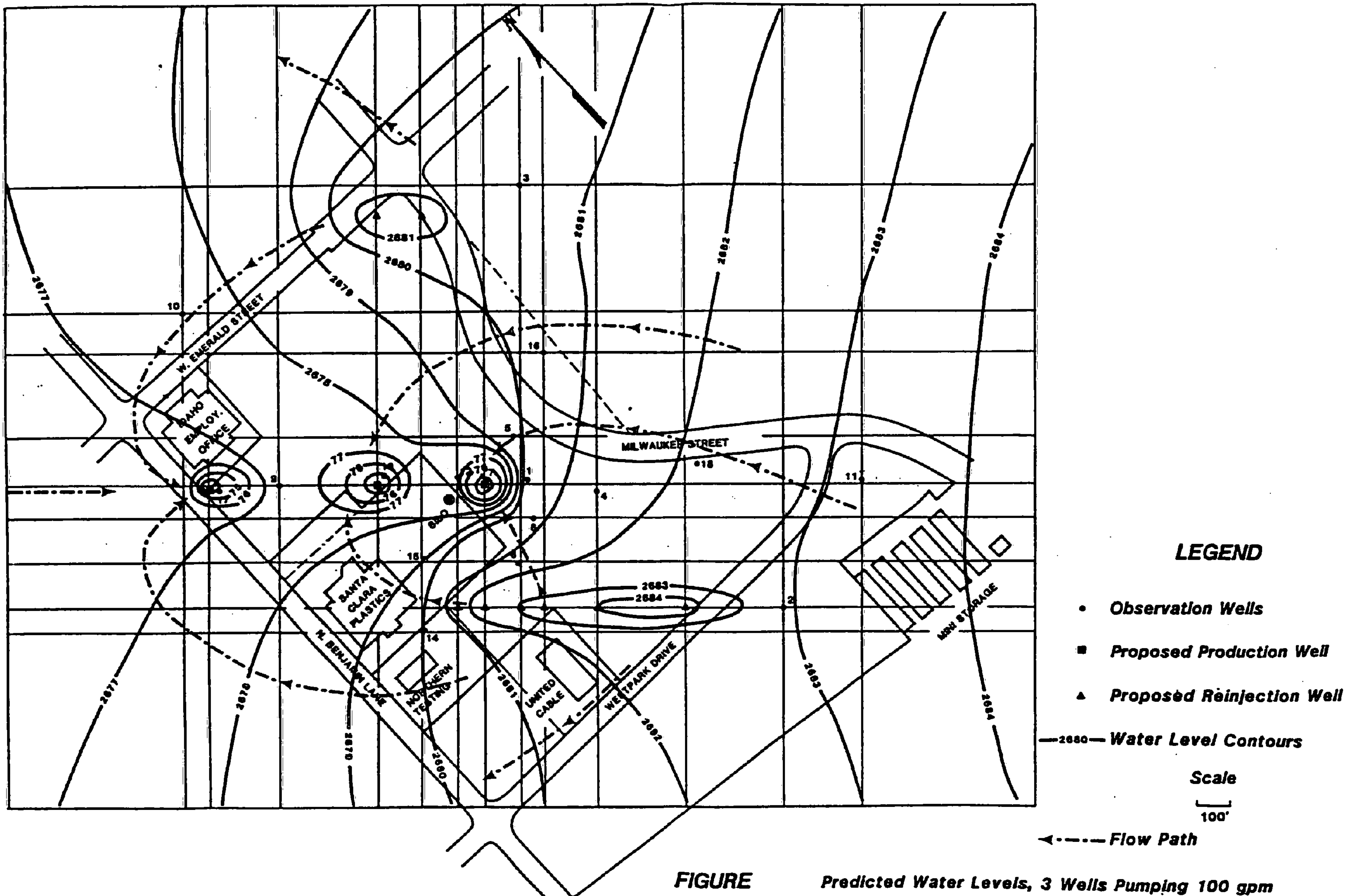


FIGURE III-9a

Predicted Water Levels, 3 Wells Pumping 100 gpm Each For 1000 Days 8 Reinjection Wells

TABLE III-I

Aquifer Test Data

WELL	DEPTH (FT)	TRANSMISSIVITY (GAL/DAY/FT)	PERMEABILITY (GAL/DAY/SQ.FT	[illegible]	TEST DATE
8	18	8,561	1,991	4.3	1/88
9	45	43,000	1,300	33	9/88
10	47	29,500	1,967	15	4/88
11	41	11,475	765	15	1/88
12	18	4,324	1,005	4.3	4/88
17	17	2,615	608	4.3	4/88

B. EXTENT OF PLUME MIGRATION AND CAPTURE ANALYSIS

Tetrachloroethylene concentrations as determined from samples collected from observation wells on the property are presented in Figure III-10. Because little offsite information is available, the downgradient extent and source of the plume cannot be determined directly. To provide estimates of the source and extent, a widely used solute transport model (Analytical Random Walk Model, Prickett and Associates, 1987) was used to simulate transport in two dimensions. The model computes changes in concentration over time caused by the processes of convective transport, hydrodynamic dispersion and retardation. A 5,000 ft. by 5,000 ft. grid was set up composed of 500 ft. by 500 ft. cells as shown in Figures III-11 to 13. The solute source was modeled as a two foot circle centered on the lower right-hand (southeast) corner of the grid. Although several simulations were run, only the three that most closely approximate the actual plume are included. Some input parameters were unknown and were therefore varied to calibrate the model. Input parameters are tabulated in Table III-II.

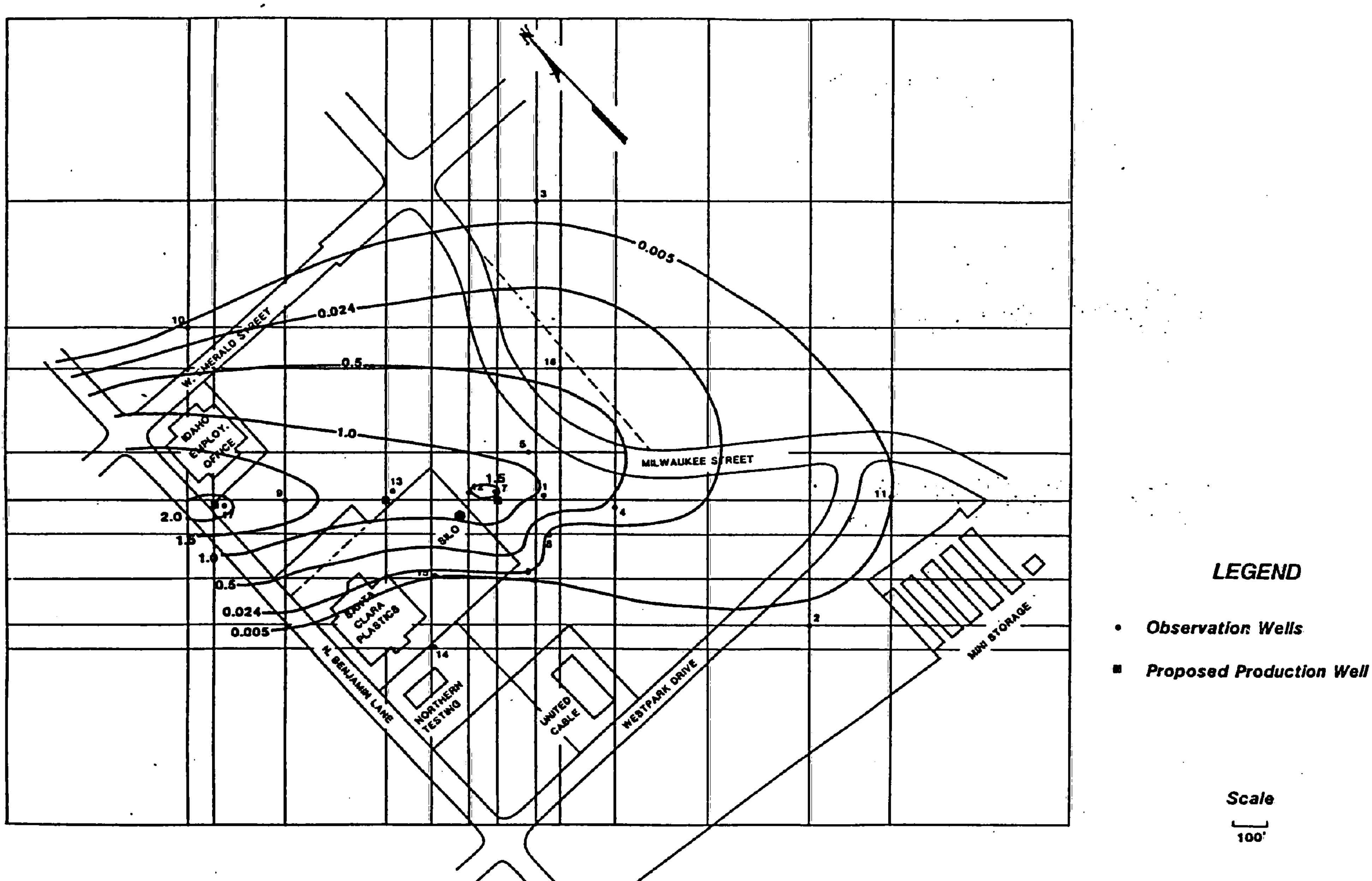
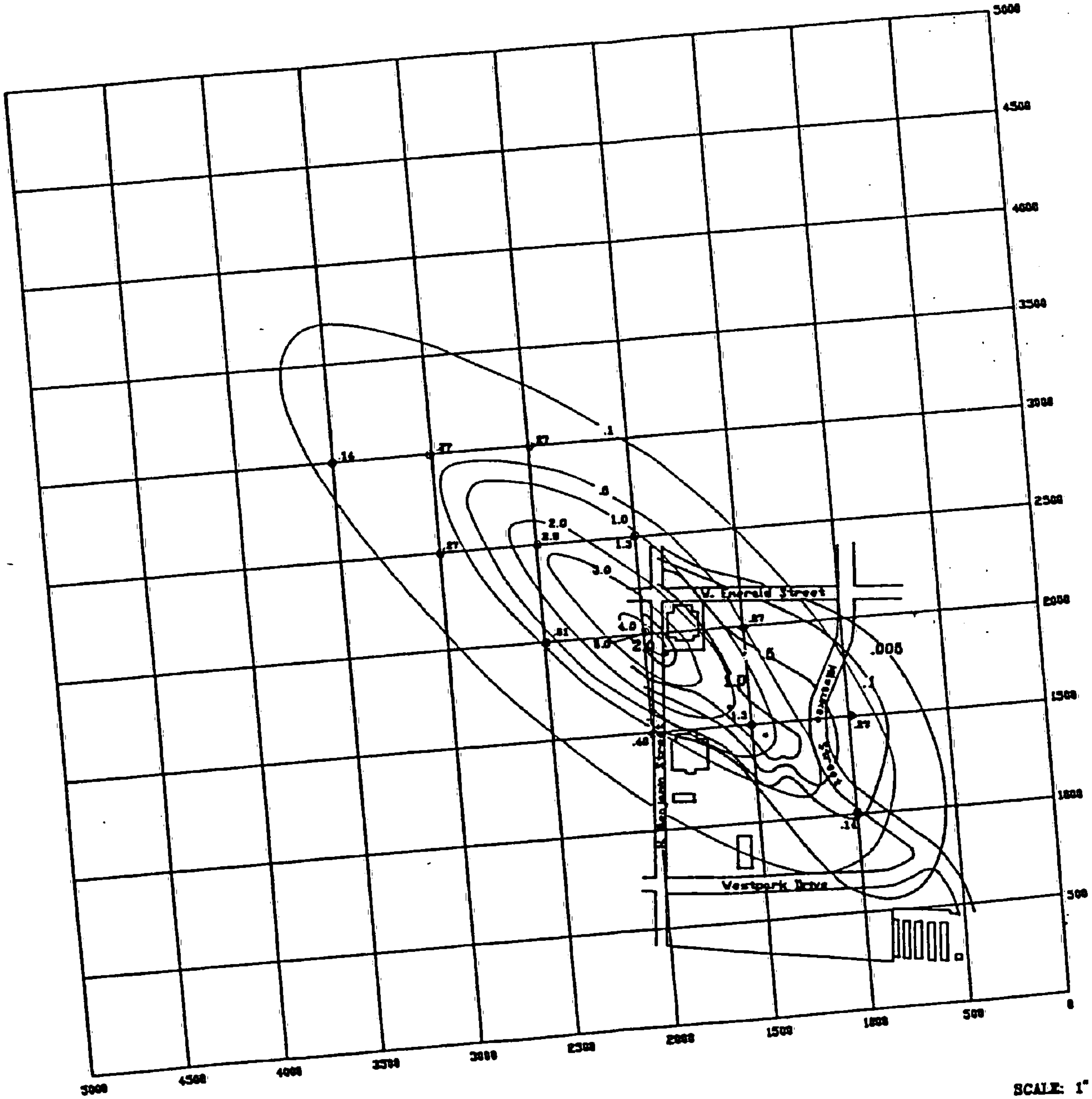


FIGURE III-10 Tetrachloroethene Concentrations (mg/l)



NORTH

LEGEND

⊙ 0.67 Tetrachloroethene Concentration (ppm) Predicted By Model

.5 —— Contoured Tetrachloroethene Concentration (ppm) Predicted By Model

.5 —— Contoured Tetrachloroethene Concentration (ppm) Estimated By SRM From Field Data

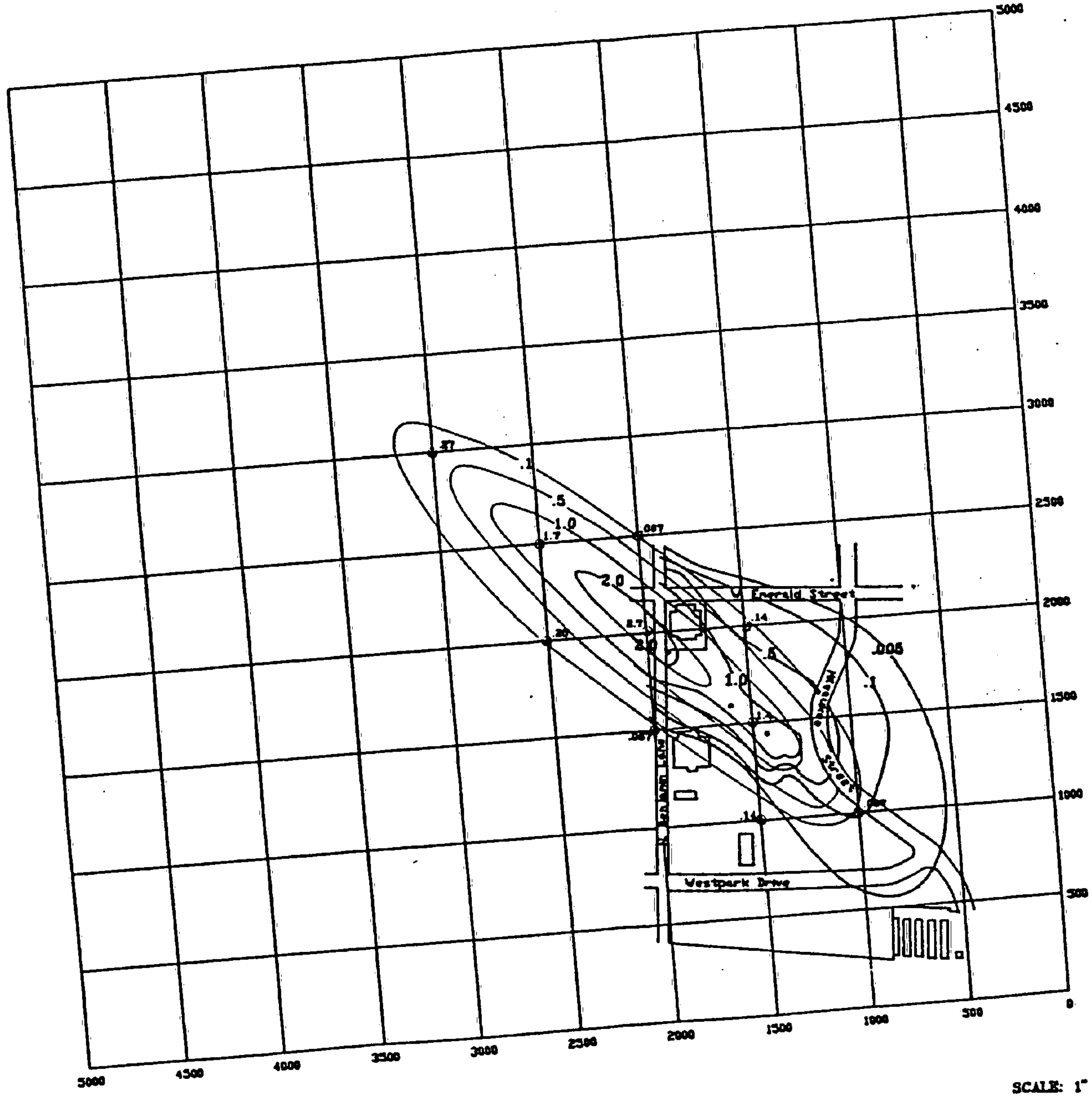
• Proposed Remediation Pumping Well

SCALE: 1" = 800 feet

Special Resource Management

Model Grid Showing Contaminant Plume From Simulation #1

FIGURE III-11



LEGEND

⊙ 0.07 Tetrachloroethene Concentration (ppm) Predicted By Model

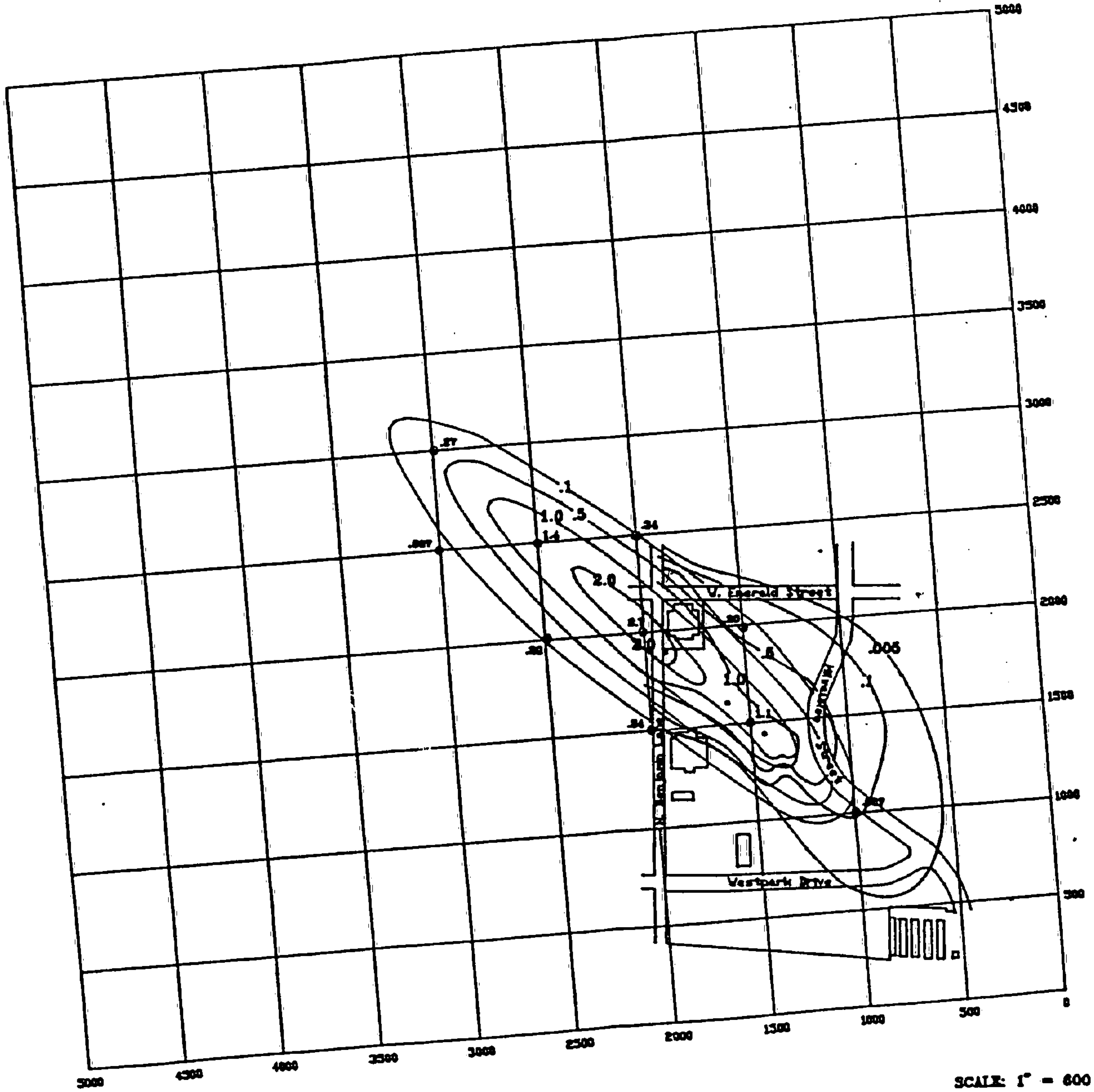
.5 —— Contoured Tetrachloroethene Concentration (ppm) Predicted By Model

.5 —— Contoured Tetrachloroethene Concentration (ppm) Estimated By SRM From Field Data

• Proposed Remediation Pumping Well

SCALE: 1" = 600 feet

Special Resource Management		
	Model Grid Showing Contaminant Plume From Simulation #2	FIGURE III-12



SCALE: 1" = 600 feet

NORTH

LEGEND

- Tetrachloroethene Concentration (ppm) Predicted By Model
- .5 Contoured Tetrachloroethene Concentration (ppm) Predicted By Model
- .5 Contoured Tetrachloroethene Concentration (ppm) Estimated By SRM From Field Data
- • Proposed Remediation Pumping Well

Special Resource Management

Model Grid Showing Contaminant Plume From Simulation #3

FIGURE III-13

TABLE III-II

Simulation Input Parameters

Transmissivity (gpd/ft)	43,000	43,000	43,000
Storativity	0.03	0.03	0.03
Retardation coefficient	1	1	1
X component of pore velocity	0.66	0.66	0.66
Y component of pore velocity	0.66	0.66	0.66
Gallons spilled	220	110	110
Time since spill (years)	9	9	8.3
Constant (C) or asymptotic (A) dispersivity	C	C	A
Maximum longitudinal dispersivity (ft)	50	60	60
Maximum transverse dispersivity (ft)	2	.8	.8

In addition to simulating the spread of the contaminant, a remediation scheme was simulated for three withdrawal wells each pumping 100 gpm until they no longer removed contaminant from the aquifer.

The simulations shown on Figures III-11, III-12 and III-13 are symmetrical because the aquifer is modelled as homogeneous and isotropic with a uniform velocity field. Simulations 2 (110 gallons spilled 9 years ago) and 3 (110 gallons spilled 8.3 years ago) provided the best fit with the actual data. Simulation 2 used constant dispersivity while Simulation 3 was run to test a hypothesis presented in literature recently which suggests that solutes approach a maximum dispersivity asymptotically over large distances. Simulation based on spills of less than 110 gallons could not produce concentrations of 2 mg/l near Well 17. Using spills greater than 110 gallons generally resulted in plumes too laterally dispersed to fit the field data as shown by Simulation 1 (220 gallons spilled 9 years ago).

Groundwater remediation by pumping the three production wells shown on Figure III-8 at rates of 100 gpm each was modeled for effectiveness using the three simulations shown in Figures III-11 to 13. Results of this effort suggest that after about two years the contaminant would be removed from under Westpark property. This would equate to about 39% of the total amount estimate to have been spilled for Simulation 1 and 48% of the total for Simulations 2 and 3 as shown by Figure III-14. In all three cases the bulk of the contaminant which had already moved past the Westpark site was not recovered, but groundwater under the site was effectively cleaned up in about two years.

IDHW requested that SRM prepare a cross section of the Westpark site for review. Three cross sections have been drawn using observation well logs from the IDWR files. PCE concentrations are included on the cross sections of the Westpark site. Figures III-15 through III-18 show these sections.

C. RECOVERY WELLS PIPING, CONTROLS AND FLOW MANAGEMENT

Recovery well locations are shown on Figures III-2 through 4 and III-9. The wells will be drilled with a forward rotary rig and will be cased with eight inch steel or plastic, depending on the driller's ability to met the bid specifications with either material. A natural gravel pack will be developed by surging with air for a minimum of two hours. Water and cuttings from drilling and development will be contained in pits adjacent to each well. The water and

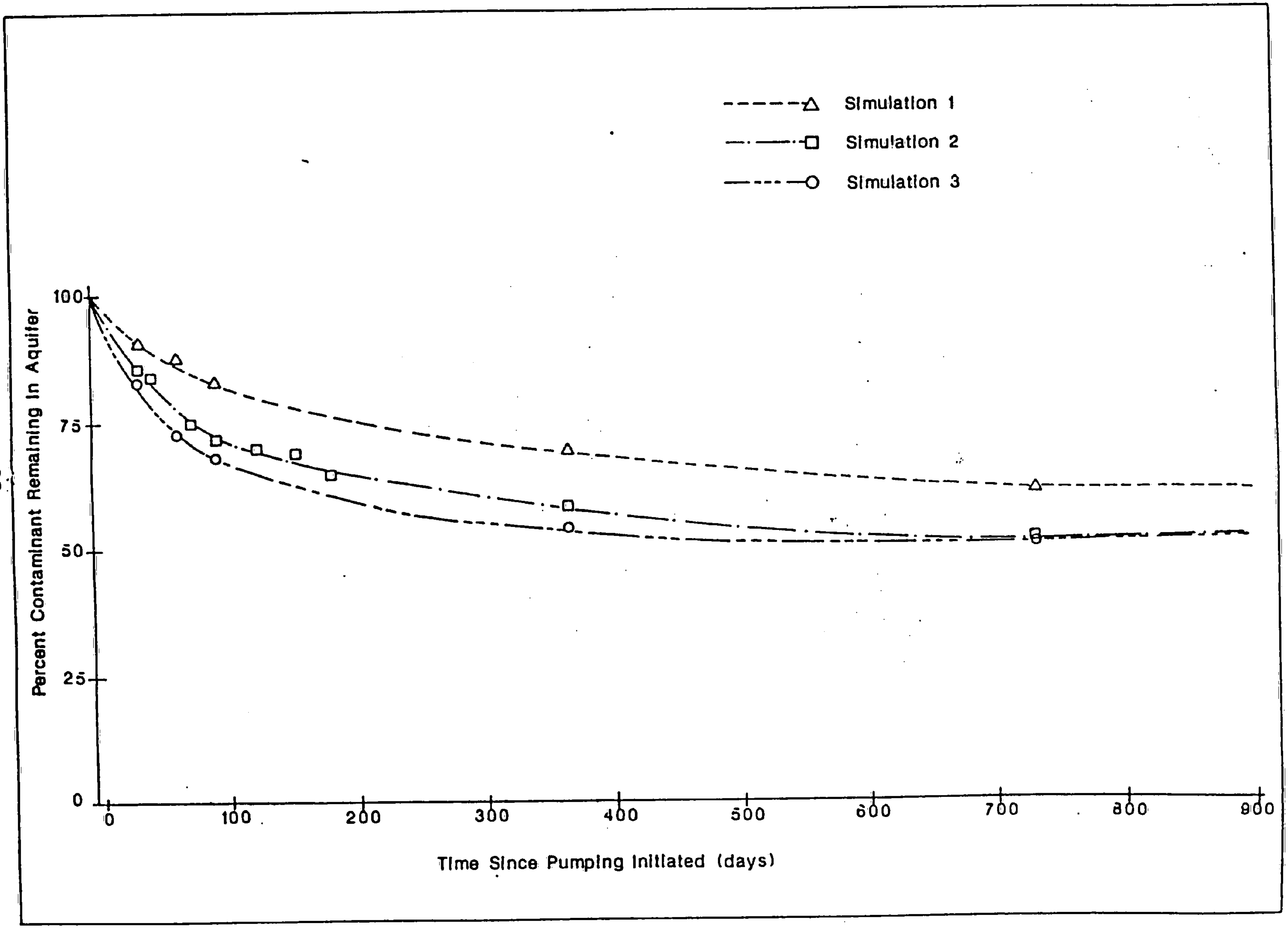


FIGURE III-14 *Effectiveness Of Proposed Remediation Scheme Under Three Modeled Scenarios*

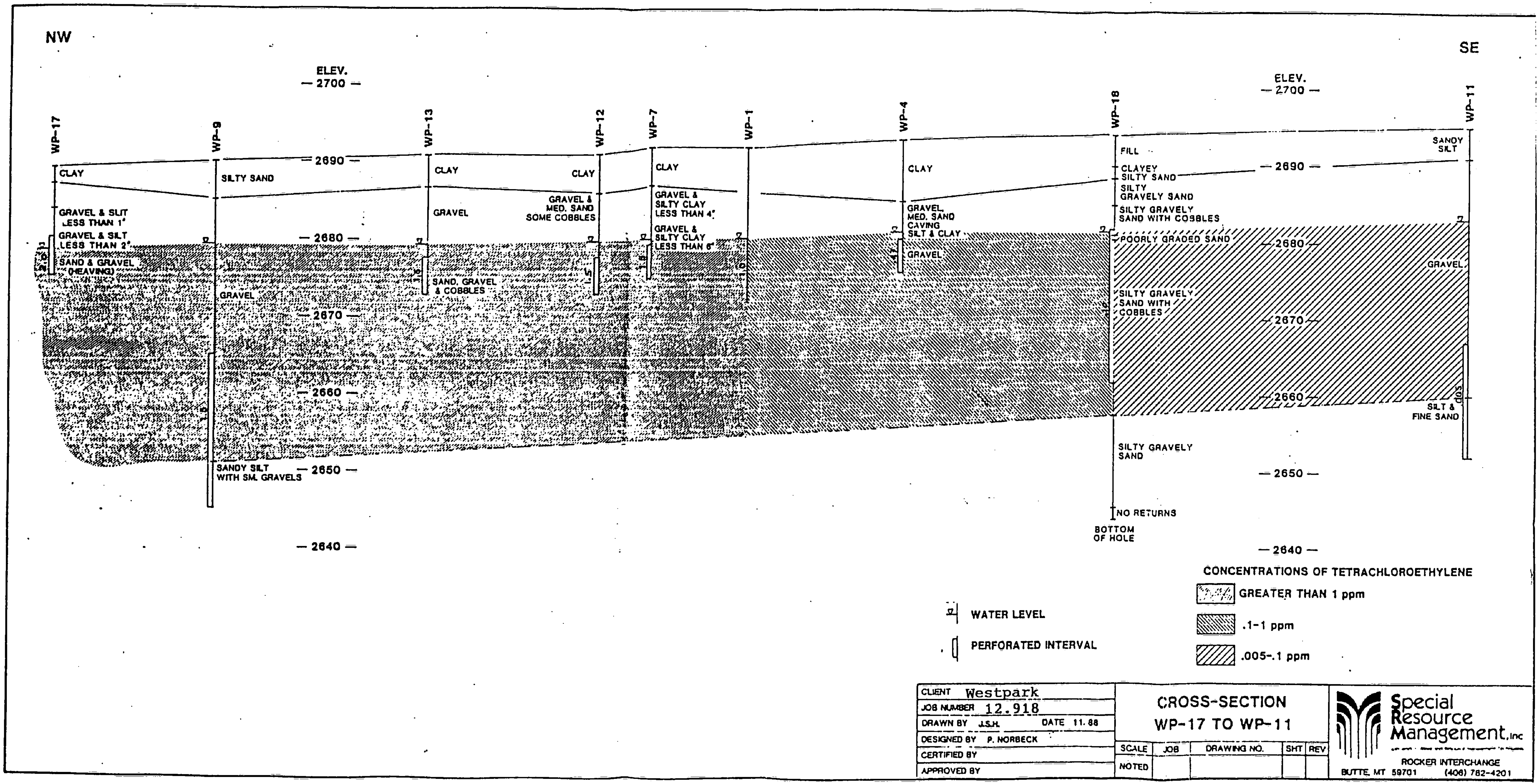
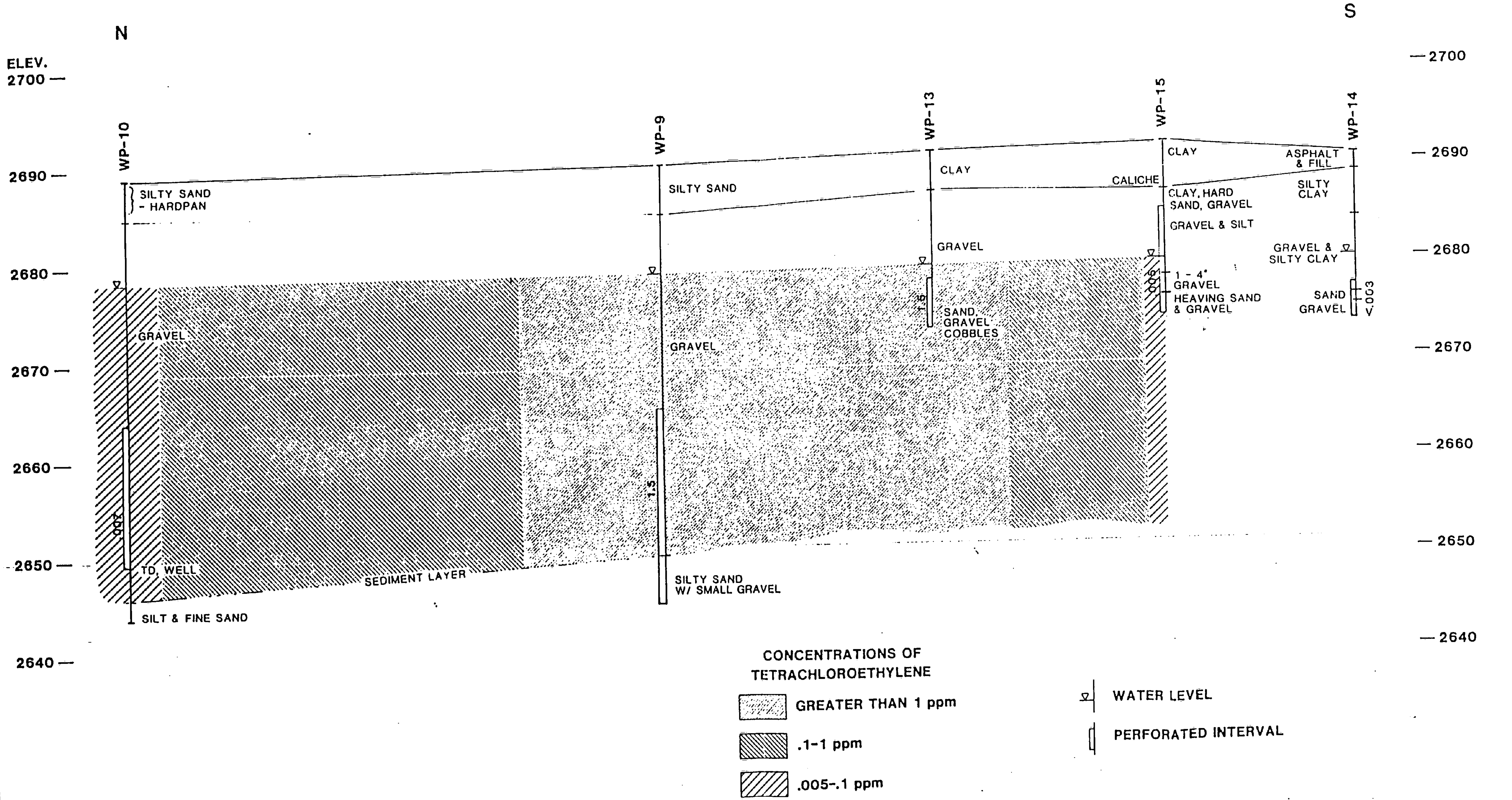


Figure III - 15



SCALE:

HORIZONTAL: 1" = 100'   VERTICAL: 1" = 10'

CLIENT	Westpark	
JOB NUMBER	12.918	
DRAWN BY	J.S.H.	DATE 11/'88
DESIGNED BY	P. NORBECK	
CERTIFIED BY		
APPROVED BY		

CROSS-SECTION WP-10 TO WP-14

SCALE	JOB	DRAWING NO.	SHT	REV
NOTED				

Special Resource Management, Inc.
ROCKER INTERCHANGE
BUTTE, MT 59701 (406) 782-4201

Figure III - 16

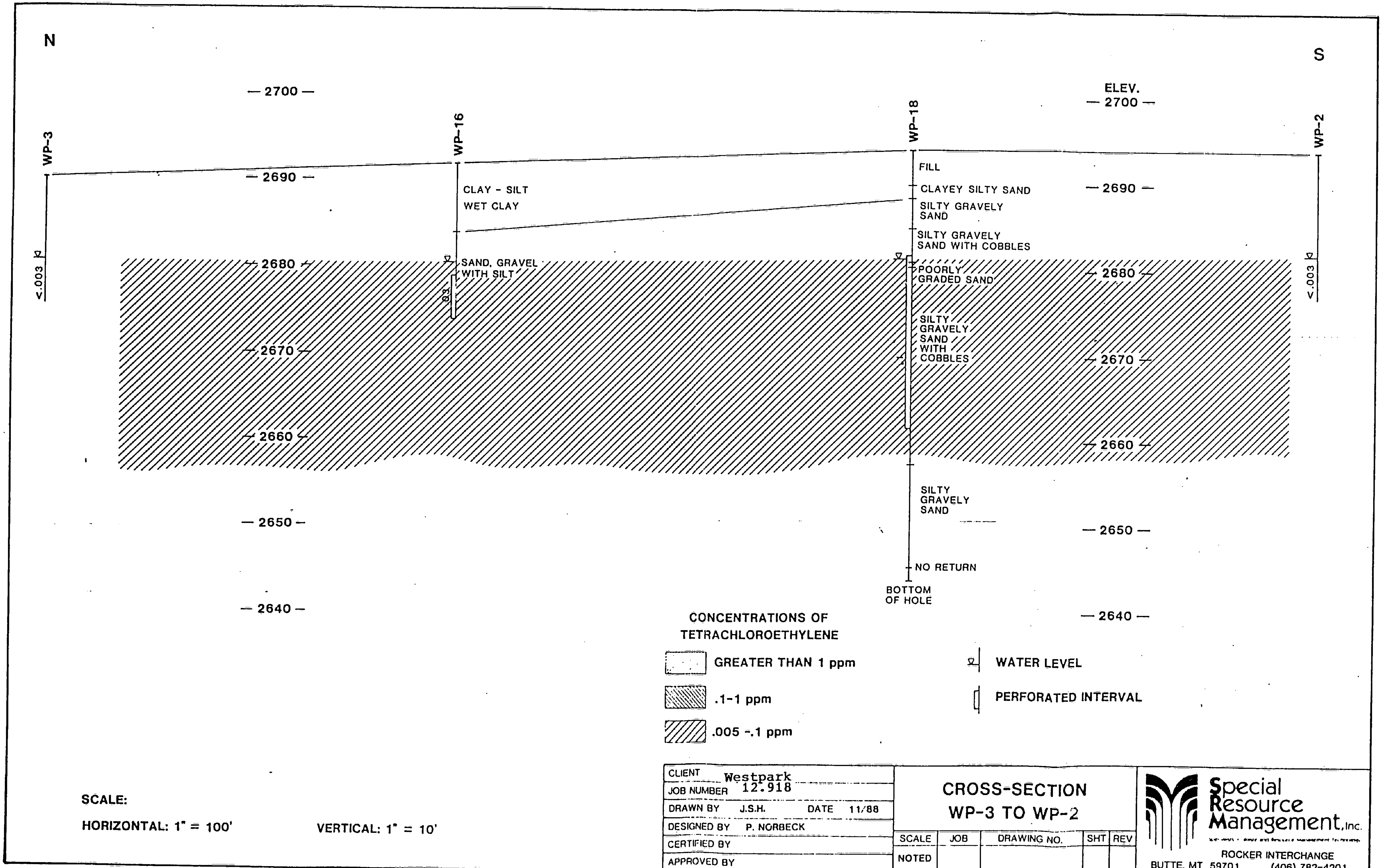


Figure III - 17

cuttings will be assumed to be contaminated, but since the aquifer under the drill sites is also contaminated, the water will be allowed to seep back into the ground for remediation by the recovery system.

Wells will be equipped with 3 hp submersible pumps (230 volt, single phase), liquid level controls, pitless adapters and will discharge through three inch pipes to the stripping column. Number 10 UP wire for the pumps and Number 14 wire for the liquid level controls will be buried along with the 3 inch pipe 36 to 42 inches below grade with a witness tape 6 to 12 inches above them. Each discharge line will be equipped with a totalizing flow meter and a gate valve just upstream of the manifold connecting the 3 wells to the stripping column. The valves will facilitate adjusting the pumping rate from each well. Sampling ports will be installed near the valves and meters.

D. GROUNDWATER PUMPING AND MONITORING SCHEDULE

The downgradient (northwestern) well, WP-3, will be turned on first at a rate of 100 gpm. The outflow from the stripping column will be sampled immediately and then weekly. When the effluent concentration of tetrachloroethylene is below 10 ppb, the center recovery well, WP-2, will be turned on at a rate of no more than 50 gpm for one week and the stripping column outflow sampled again. When the outflow is again below 10 ppb the third well, WP-1, will be turned on at a rate of no more than 50 gpm until the outflow is below 10 ppb based on weekly samples. The pumping rates for Wells 1 and 2 will then be adjusted upward based on weekly samples of the stripping column outflow to the maximum flowrate of 100 gpm per well. Each well will be sampled when the system is started and then quarterly. When the system is running at capacity, the stripping column outflow will be sampled quarterly.

Groundwater samples will be taken from various monitoring wells on a quarterly basis to determine the effectiveness of the recovery system (see Section VI A; page 54).

Additional monitoring wells will be drilled by the driller who installs the recovery wells as part of the same contract. New monitor wells will be 2 to 4 inches in diameter, 40 feet deep (sump to 45 feet) and, if possible, cased with plastic.

IV. AIR STRIPPER DESIGN AND OPERATION

A. AIR STRIPPER - GENERAL PROCESS DESCRIPTION

The technology of using air stripping is well proven in removal of volatile organic contaminants from water (Refs. 9, 10, 11). Air stripping is most commonly accomplished with the use of packed columns, although alternatives such as cooling towers and centrifugal strippers have also been used.

A packed column stripper, consisting of a vertical tubular column, ranging in height (Depending on the application) from a few feet to over 30 feet, is most commonly used. The column has piping and venting connections to allow liquids to flow downward through the column and be collected and discharged at the bottom of the column, while at the same time allowing air (which is the stripping gas) to be blown by a fan into the bottom of the column and discharged at the top.

The technology works on the principle that a volatile water contaminant will tend to vaporize into the gas (air) stream through which the water is passing. One purpose of the packed tower is to provide a large amount of liquid to gas (or water to air) surface area to allow the liquid contaminant to vaporize into the gas. In order to maximize the amount of area in which the water and air are in contact with each other, a packing material is used in the column.

The packing disperses the air and the water, causing them to flow over the packing surfaces resulting in increased air to water surface area.
The air and water typically flow in opposite directions through the column, which allows the maximum amount of contaminant to be removed from the water for a given amount of air flow.

The stripping column is operated by pumping the water to be stripped to the top of the unit, where it flows downward over the packing. The water flow is controlled by valves and instrumentation in order to maintain a constant flow rate. Air is blown by a fan into the bottom of the column just under the packing support. As the air flows upward through the column, it picks up vaporized contaminant from the water, and the air exits at the top of the column where it is vented to the atmosphere. Stripped water, depleted of the contaminant, is discharged from the bottom of the column by a level control device.

Instrumentation or manual controls are required to maintain pumped water flow at a uniform rate to the column, and to allow the stripped water to be discharged from the column. Air flow to the column is typically not varied, but allowed to flow at the blower capacity. For a given column diameter and packing height, the column performance, or removal efficiency, is then controlled by the flow of contaminated water to the unit. Generally, lower flows will result in higher removal efficiencies.

B. SYSTEM SIZING AND DESIGN

The air stripping system will be designed to handle a flow of 300 gpm of contaminated water, reducing the contamination level to under 10 ppb PCE prior to discharge. As the contaminated aquifer becomes cleaner over a period of time, the concentration of PCE fed to the stripper will decrease. As a result, it should be kept in mind that the air stripper if designed to remove the maximum observed concentration, will become over designed at a later stage of the cleanup.

In order to provide an economical unit, the air stripper water inlet concentration used for design purposes was 1.7 mg/1, which is approximately 1.7 ppm or 1,700 ppb by weight. This represents the expected concentration at 100 gpm pumping volume from each of wells WP-3, WP-2, and WP-1 (300 gpm total). With this design parameter set, the stripper will also be able to accommodate the 2.4 ppm concentration from well WP-3 at a flow rate of 100 gpm during startup of the system as discussed later in Sections C, F and G.

To achieve a removal or PCE from 1,700 ppb, a packed stripping column was selected with a 4.0 foot diameter and an overall height of 25.1 feet. The effective packing height is 18.5 feet. An air flow to the stripper of 8,000 SCFM will be required. A commercially-available air stripper meeting these specifications should be readily available, such as Delta Cooling Towers, Inc. Model S4-185SH-T, or equivalent.

The general process for the proposed stripping system is shown in the Piping and Instrument Diagram, Figure IV-1. Contaminated water from wells WP-1, 2 and 3 will be pumped by the submersible pumps P=1, 2 and 3 via buried 2 inch piping to the treatment site. The flow from each of those pumps will be individually valved and metered with a flow indicator. Flow will be controlled to the stripper by manually setting the valves to specific flow rates as read on the flow indicators.

Each individual line from the wells will then be headed into a 4-inch supply pipe feeding the top of the stripping column. A sampling valve will be placed to allow inlet water samples to be taken. Water will flow down the column packing and will exit the stripper into discharge pump P-4.

Water discharged from pump P-4 will flow branch into two sewer discharge lines which can individually be controlled by manual valve settings. Flow totalizing meters will be installed to record quantities of water discharged to sewers on North Benjamin Lane and Westpark Drive, respectively.

Air flow will be supplied to the stripper by a 5 HP fan, F-1, close-coupled to the stripper. The stripper will be equipped with a demister at the air exit at the top of the column, in order to reduce entrained water in the exiting air.

The system will be designed with flow sensors to ensure air flow from the fan, level controls to assure adequate water levels in the wells, level controls and switches to control the water level in the stripper sump, and temperature controls and a heater to protect the sump in near-freezing operation. The protective features provided by these instruments are described further in Section D.

It is expected that the stripper will be operated on a 365 day per year basis, although winter conditions may reduce the stripping efficiency (Refs 11, 18), necessitating reduced pumping rates. This will be determined by field operation, as will the specific of potential ice formation related to encountered air and groundwater temperature. Regular system operational monitoring, as described in the following Sections, will provide data needed to make any operational adjustments to the system.

C. OPERATING PROCEDURES

Scope and Purpose

This procedure encompasses the operation of the air stripper equipment, water feed system and water discharge system.

The purpose of this procedure is to provide operating guidelines for the air stripping equipment in place for the Westpark groundwater Remediation Project. It is intended that correct application of these procedures will ensure safe and environmentally compatible operation of the system.

References

The following references should be consulted during all phases of air stripping Operation:

- Manufacturers documentation of air stripper equipment.
- Manufacturers documentation of water pumping system.

Prerequisites

Prior to operation of the air stripping equipment, the Operator shall have read and understood these procedures, as well as, all the manufacturer's documentation relevant to the system operation. In addition, the Operator shall have received training from the Project Supervisor on system operation. Operator Training is addressed in Section IV-E of this document. The Project Supervisor will be knowledgeable in the operation of the system and will be responsible for the proper operation of the system. The Project Supervisor will maintain records of system operating parameters and will be responsible for preparing project reports and providing notices to IDHW when needed. The Project Supervisor will be located in the Boise SRM office and will consult with SRM's engineers and hydrologists as needed to insure maximum system performance.

Equipment and Supplies

Operation of the system requires the following equipment and supplies:

- Water Sample Jars
- Cooler for Shipment of Water Samples to Lab
- Air Sampling Supplies
- Tool set including wrenches and socket set

When the final air stripper model is selected, an assessment will be made as to the availability of replacement parts. If major replacement components can not be received in Boise, Idaho within three weeks of order, extra parts will be ordered and stored in Boise in case of failure (blower fan, sump pump). SRM does not anticipate any delays in receiving replacement parts since the equipment is not custom made.

Precautions

The following factors shall be kept in mind during system operation:

- It is imperative that un-treated water not be discharged to the sewer. If it is suspected, that the system is not operating correctly, shut the system down immediately and notify the Project Engineer.

- If the system is shut down during freezing ($32^{o}F$) temperature conditions, drain all piping and, if the sump heater is down also, drain the sump. The mist eliminator must also be inspected prior to system start-up.

Start-up Procedures

For initial start-up of the system, the submersion pump furthest downstream will be turned on with the valve completely open, i.e. 100 gpm. Once equilibrium is reached, inlet and outlet streams will be sampled. These samples will be sent into a laboratory for analysis and these results will be used to determine the efficiency of the air stripper at this flow rate. Once the air stripper is removing PCE to below 10 ppb, a second pump will be turned on with the valve throttled to 50%, i.e. 50 gpm. Again equilibrium will be reached, the streams sampled, analyzed, and the results will be used to determine when the remaining pump can be started up at 50 gpm. These steps will be repeated until all three pumps are running at 100 gpm each. If the original outlet stream concentration is not below 10 ppb, additional samples will be taken at prescribed increments to determine when the flow rate can be increased.

NOTE: Notify water treatment plant if the outlet concentration of PCE is above 10 ppb.

The specific, stepwise procedures which the Operator shall follow are listed below:

1. Ensure all piping connections are secure.

   NOTE: During initial start-up, the Project Engineer <u>and</u> Operator will be present. If the system must be started-up at another time, the Operator shall notify the Project Engineer.

2. Ensure the mist eliminator and the air fan intake are free of obstruction and turn the fan on.

3. Inspect all valves in the water <u>supply</u> system and ensure only the valve for the pump furthest downgradient is open, (P-3, see Piping and Instrument Diagram, Section B, of this Document). The other two (P-2 and P-1) should be closed. Turn on the submersible pump P-3. Once the water level in the stripper sump is at the desired level, start up the discharge pump P-4 and adjust the water control valve downstream of the discharge pump to obtain the specified level setpoint. Adjust the control valve from pump P-3 until a flow of 100 gpm is achieved.

4. Allow the system to reach equilibrium and then sample the influent water, effluent water, and exiting air. label the water samples, prepare a sample chain of custody form, and place the samples on ice for shipment. Record the water flow rate at the working pump and at each discharge valve. Continue the system operation.

5. Send the samples to the laboratory for analysis. Report the results to the Project Engineer. Using the analytical results, the Project Engineer shall calculate and record the efficiency of the air stripper. The Project Engineer shall then compare and record the calculated efficiency to that of the manufacturer's specifications, and determine the outlet concentration of the system when the water flow rate is increased by at least 50 gpm, using data on inlet concentrations and the manufacturers specifications on efficiency at the new flow rate. If the outlet concentration is calculated to be below 10 ppb, the Project Engineer shall instruct the Operator to proceed with flow adjustment by following step 6. If the calculated value is above 10 ppb, the Project Engineer shall instruct the Operator to continue to run the system at present settings for one week.

6. Inspect the valve connected to pump, P-2, and ensure it is open for a flow rate of at least 50 gpm. Turn on this pump and adjust the water control valve from pump P-2 to obtain the flowrate specified by the Project Engineer. Readjust the valve from pump P-3 to maintain 100 gpm. Operate the system at the new settings for one week. Steps 4, 5, and 6 should be repeated sequentially for pumps p-2 and P-1, until the 3 pumps are each supplying 100 gpm (300 gpm total) to the stripper.

Shut Down Procedure

If the system must be shut down, turn off the water feed pumps (P-3, P-2, and P-1) first, then the discharge pump (P-4), and then the fan (F-1. Once the feed pumps are turned off, the low level switch should trip the discharge pump off, which will then turn off the fan.

Start-up Inspection Procedures

During start-up (operation at less than 300 gpm) the system will be inspected daily for the first month. In addition it will be inspected daily for a week after any flow rate change, followed by an inspection of at least three times a week between flow rate changes. The inspection will encompass the readings and inspections specified in the Daily Operating Procedures below.

Daily Operation Procedures

On a daily basis, the Operator shall perform a system inspection, record data, and make system adjustments. Data and observations shall be recorded by the Operator in a permanent log book. Once a trouble-free operating history has been established for a period of one month at 300 gpm total flows, the frequency of operator site attendance will be reduced to three times per week.

1. Inspect the air fan intake and the mist eliminator to ensure they are free of obstructions. Proper operation of the system is dependent upon correct air flow.

2. If the system appears to be malfunctioning, shut the system down immediately as described under Shut Down Procedure, above and notify the Project Engineer.

3. Record the gpm reading from the water flow meters. If these gpm readings are out-of-specification, adjust the appropriate control valve to being the flows within specification. Record the stripper packing differential pressure. Make note of required maintenance. Record all data in the log book. Report data to the Project Engineer.

4. Ensure that the site is locked up and secure after each visit.

Monthly Operating Procedures

On a monthly and then quarterly basis, sample the influent water and effluent water. Submit the samples to the chemical laboratory for analysis. Submit the results to the Project Engineer for calculation and recording the system efficiency.

D. FACILITY CONTINGENCY PLAN

Scope and Purpose

This plan covers Operator responsibilities and the controls of the pumping and air stripper system in the event of equipment breakdown.

This contingency plan is designed to minimize risks to human health and the environment from the accidental release of untreated groundwater at the Westpark Groundwater Remediation Project.

Equipment Location

Each piece of equipment is shown schematically on the Piping and Instrument Diagram (P&ID), Figure IV-1 of this document. All equipment shown will be located on the process slab, except for production well pumps, P-1, P-2 and P-3.

Operator Responsibilities

1. Operator will follow operating procedures, thus reducing the possibility of an incident occurring.

2. If the system is shut down, the Operator shall notify the Project Supervisor who will initiate steps to bring the system on-line and provide notice to IDHW.

3. Freezing weather requires that all piping must be drained and the air stripper sump emptied (unless the sump heater is still working) when water flow to the stripper is halted.

4. The Operator shall inspect the mist eliminator during freezing conditions prior to starting the system up after any period in which the system has been shut down.

5. If the Operator observes or suspects any problems with the system, the Operator will notify the Project Supervisor who will assess the concerns and take appropriate action (i.e., system adjustment, IDHW notification, or shutdown).

Project Supervisor Responsibilities

1. The Supervisor will maintain system operating records and direct system adjustments to ensure maximum system performance.

2. Prepare Client and IDHW reports on system operation and cleanup efficiencies (see Report Discussion in Section VI).

3. Notify IDHW in the event of any system upsets or expected system shutdown.

4. Review groundwater sampling results and assess data quality in terms of Project quality control limits.

5. Operate the treatment system in accordance with Project permits and agency agreements.

Fan Failure Contingency Control Feature

1. A flow switch, sensing the flow of fan air through the stripper, will trip the supply pumps off if the air flow rate is reduced below 80% of the design rate.

2. Tripped-off supply pumps will cause the water level in the sump to be reduced. The low level switch will trip the discharge pump off which, after a delay, will trip off power to the fan.

Inlet Pump Failure Contingency Control Feature

A level controller in the stripper sump will control outlet valve from the air stripper. If a level cannot be maintained in the sump, (due for example, to supply pump failure) a low level switch will trip the supply pumps off, followed by the discharge pump being turned off. Once all pumps are tripped off, the fan will be shut down by a timed delay switch.

Outlet Pump Failure

A level controller in the sump will control the outlet valve from the air stripper. If this controller cannot control a high level in the sump, a high level switch will trip the inlet pumps off, followed by the discharge pump being tripped off. Once all pumps are tripped off, the fan will be shut down by a timed delay switch.

Freezing Conditions

A heater will be located in the sump. It will be activated by a temperature sensor. When the water temperature falls below a set point (approximately $35^{\circ}F$) the heater will turn on. Based on experience gained during freezing conditions, the air stripper may be insulated, and heat tape installed under the insulation. Both options depend upon the time of year start-up occurs and the ensuing operating conditions. The sump heater is shown in the Piping and Instrument Diagram, (see Figure IV-1).

A mist eliminator will be installed in the top of the air stripper to reduce the amount of water droplets emitted into the air. This will reduce the amount of liquid that condenses or freezes outside the air stripper during cold conditions. The mist eliminator must be inspected prior to system start-up if the system has been shut down during cold weather.

E. OPERATOR RESPONSIBILITIES AND TRAINING

The Operator shall be responsible for day-to-day system operation and minor maintenance in accordance with operating procedures. The Operator will also be responsible for reporting operation and maintenance data and major maintenance needs to the Project Supervisor.

Operator training is the responsibility of the Project Supervisor. Pre-qualifications for the system operator will be 40 hours of training for work on hazardous materials sites, in accordance with 29 CFR 1910.120 OSHA regulations. Prior to system start-up, the Project Supervisor shall spend a minimum of one day familiarizing the Operator with the specific of the air stripper operation. At a minimum, the following topics shall be discussed with the Operator:

- Site Security
- Mechanical Systems Safety
- System Start-up
- Operator Monitoring
- Air Sampling Procedure
- Water Sampling Procedure
- System Shut-down
- Chemical Safety and Hazards Associated with Perchloroethylene Air Stripping

F. TREATMENT SYSTEM STANDBY DURING ASSESSMENT MONITORING

During assessment monitoring, the treatment system will be shut down while the groundwater is monitored for any remaining contamination. All piping and pumps will be drained, any residual water in the air stripper drained into the sump, the air stripper sump emptied, and the air exit vent covered. If the system must be started up again, the Operating Procedures will be followed.

G. SCHEDULE FOR IMPLEMENTATION

The schedule for treatment system construction is dependent upon several factors. In general, it is expected that implementation will begin after all necessary permits are obtained. Figure IV-2 shows the expected time line for system procurement, construction and startup. SRM anticipates having contracts and agreements in place to begin implementation 30 days after the required permits are in place. Therefore, it is anticipated that the system will be operational in about 9 weeks after permits are in place.

ELH 11/02/88

WESTPARK PROJECT 12-0918-01

SCHEDULE FOR IMPLEMENTATION OF REMEDIAL ACTION

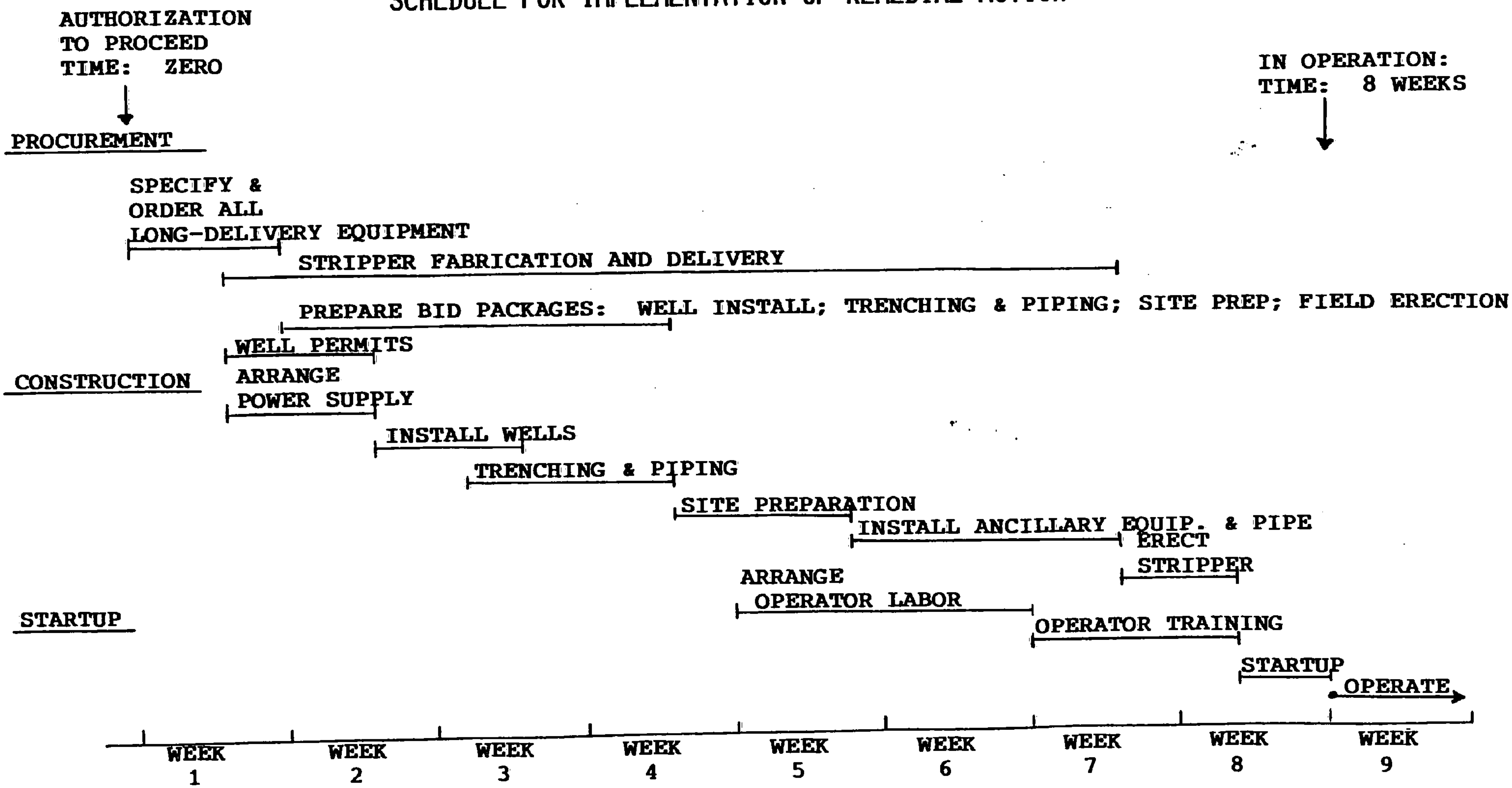


FIGURE IV-2

V. TREATED WATER DISPOSAL

A. DISCHARGE TO WEST BOISE SEWER DISTRICT

Treated water from the air stripping operation will be discharged to the West Boise Sewer District (WBSD). A six inch diameter sewer line will be installed underground between the water outlet of the air stripping column and the existing ten inch sewer line located under Westpark Drive. Approximately 200-250 gpm will be discharged through this six inch sewer line. An additional four inch sewer line will be installed between the air stripping column water outlet and the existing eight inch sewer line located under Benjamin Avenue. This four inch line will also be installed underground. Both discharge water sewer lines will have water flow meters to measure total treated water. Gate valves will be installed on each of the discharge lines to shut off discharge to the sewer should it be necessary.

Treated water from the air stripping operation is predicted to contain 10 ppb or less of PCE. As discussed previously in Section IV H, discharge water will be monitored carefully to ensure that this 10 ppb PCE discharge concentration is not exceeded. Section VI-A discusses the schedule for effluent sampling during startup and full operation. The first discharge samples will also be analyzed for BOD and total suspended solids. The WBSD will be allowed access to effluent sampling points for independent sampling.

B. REINJECTION OF TREATED WATER

As an alternative to sewer disposal of treated water (described above), the treated water may be disposed of by a groundwater reinjection technique. To implement this disposal option, reinjection wells would be placed at locations north and south of the contaminant plume. Injection wells and piping would be placed near property boundaries to facilitate construction of the mall. Treated discharge water from the air stripping operation would be pumped to each of these wells and the treated water would be re-introduced into the groundwater at a rate of approximately 75 gpm.. A possible benefit of this option is that the resultant groundwater mounds north and south of the containment plume would act as barriers and prevent groundwater movement from outside the containment zone. Also, if there were other types or zones of contamination outside of the known containment plume, this disposal technique would prevent the outside contamination from entering the pumping wells. The reinjection wells will be located away from foundation areas.

The added cost of constructing the required reinjection wells, and the extra piping from the stripper discharge to each of the wells would be more costly than the alternative of discharge to the sewer. Two reinjection scenarios are being considered for the effluent water. The first system includes installing 4 reinjection wells approximately 45 feet deep. Figure V-1 shows the location of the four reinjection wells and the piping easement. The piping easement will be established so that access will be guaranteed until final cleanup is accomplished. Figure V-2 shows a reinjection scenario of 8 reinjection wells 18 feet deep. The predicted water levels for 1000 days of operation are shown in Figure V-2. The well locations may need to be adjusted to facilitate site development.

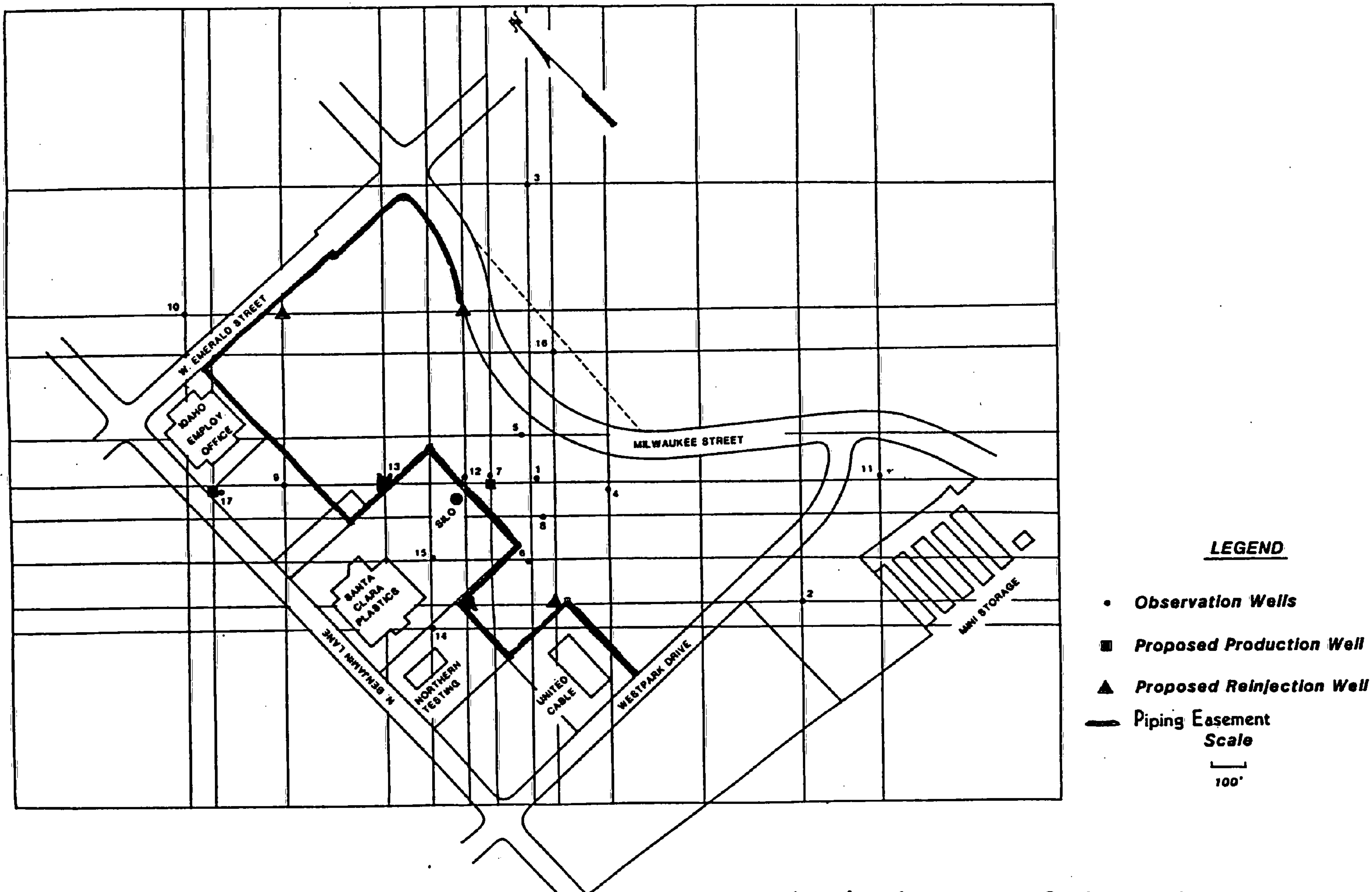


Figure V-1 Injection Well and Piping Diagram

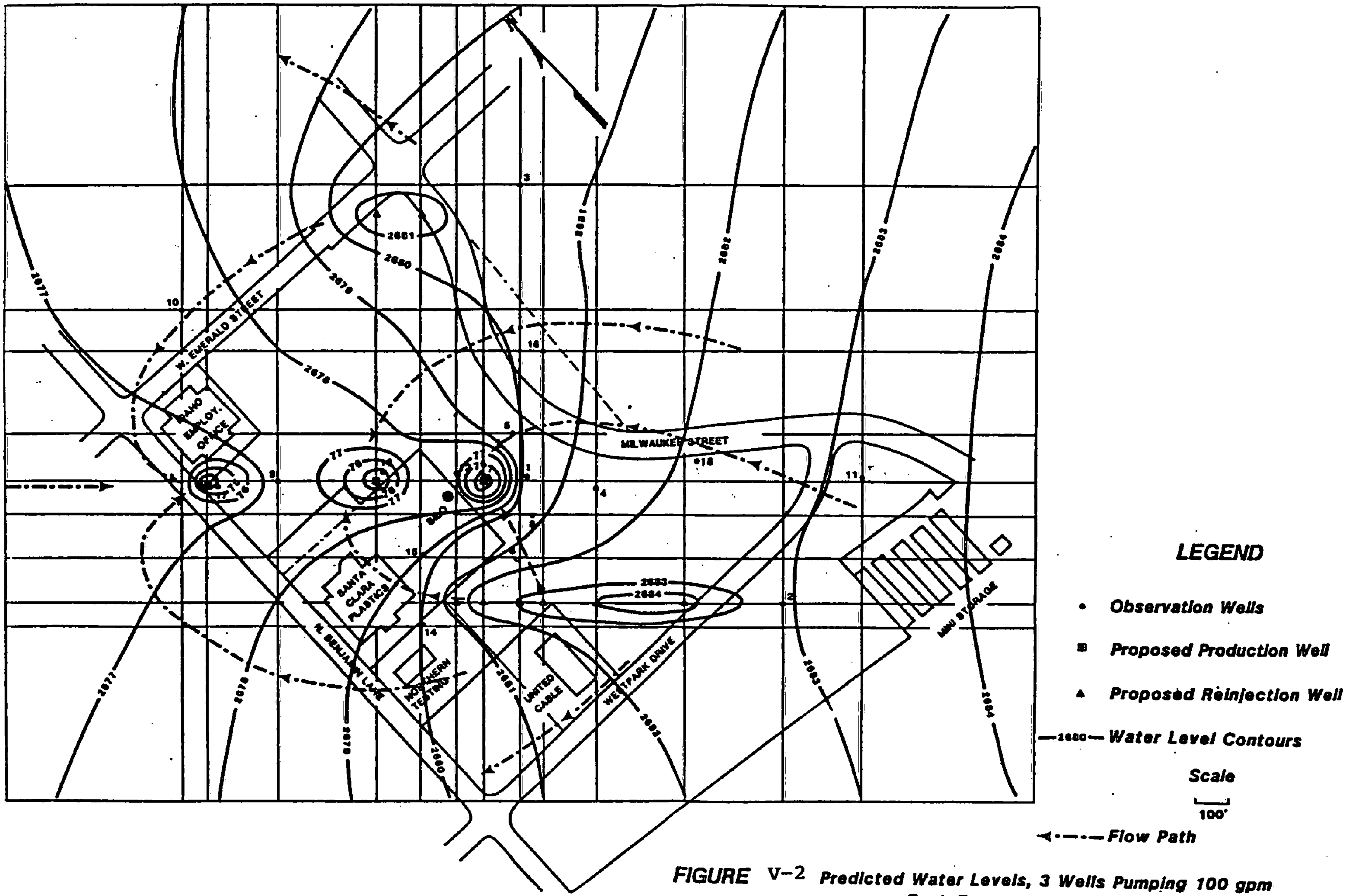


FIGURE V-2 ***Predicted Water Levels, 3 Wells Pumping 100 gpm Each For 1000 Days 8 Reinjection Wells***

VI. GROUNDWATER MONITORING

A. BACKGROUND

The groundwater monitoring program for the Westpark site is a key element in the remedial action plan. The groundwater monitoring data will be used to determine both cleanup efficiency and completeness of treatment. The circumstances surrounding the PCE contamination at Westpark are atypical and require a general understanding in order to understand the objectives of the proposed remediation monitoring program.

The following items reflect Westpark's appraisal of the contamination and have been discussed in earlier reports or other sections of this report and are repeated here for general information:

- To the best of Westpark's knowledge, no previous landowner of Parcel #1 conducted a business that used tetrachloroethene or generated tetrachloroethene as a waste. Westpark is unaware of any PCE dumping on the property and no disposal site has been identified from SRM's soil sampling.

- Soil Sampling conducted by SRM on Parcel #1 has not identified any potential PCE source areas on the property.

- The aquifer characteristics, PCE sampling data, and plume modeling conducted by SRM indicates that the most likely source area is to the southeast of Parcel #1. IDHW feels that there is insufficient data to determine the source location and that various modeling scenarios can result in different estimates of source location.

- Although there are no monitoring wells to the SE and east of Westpark's property, it is possible that some level of PCE exists under the farm land and commercial property to the East and SE of Parcel #1.

- While there is no laboratory evidence of contamination to the SE of the Westpark properties, if it does exist, it may migrate under the Westpark site during the treatment and assessment monitoring period since groundwater flow direction is northwest.

- The primary objective of the Westpark treatment plan is to quickly as possible reduce the public's risk associated with the PCE contamination in the sand-gravel groundwater system to the 40 foot level.

- Some off-site groundwater will be treated during the remediation (primarily from NW of the site) due to the location of the pumping wells and the various surface ownership patterns above the plume. The purpose of the treatment plan as stated above is to reduce the PCE contamination in the groundwater under the Westpark Parcel #1. Treating off-site contamination SE of Parcel #1 will inadvertently occur during the approximate 2 year treatment plan, however, it is not the objective of Westpark to treat contaminated groundwater under adjacent property.

- If a continuing PCE source area exists to the SE or if there is a large volume of PCE contaminated groundwater to the SE, the corrective action and assessment monitoring will provide information to help assess the situation.

- IDHW and Westpark Partnership will be reviewing site monitoring data for at least 4 years.

Two types or time periods of groundwater monitoring will be performed at the Westpark site. During the period of groundwater treatment, corrective action monitoring will be conducted to demonstrate the effectiveness of the remedial action plan and to determine when the 10 ppb clean up goal has been reached. Assessment monitoring will be performed after the treatment and pumping has stopped.

Table VI-1 and Figures VI-1 and VI-2 summarize the wells proposed for use during the Westpark treatment and assessment period. Monitoring wells may be dropped or sampled less frequently if the results from two consecutive quarters indicate the PCE concentration has been reduced to 10 ppb or less. Wells will be removed or sampled less frequently upon the mutual agreement of Westpark and IDHW.

Table VI-I
Westpark Well Utilization Summary

Pumping Wells		Corrective Action Monitoring	Assessment Monitoring	
WP-1		WP-1	WP-1	
WP-2		WP-3	WP-3	
WP-3		9	11 (biannual)	
		11 (biannual)	19	
		19	20	
		20	21	pair -
	pair -	21	16	alternate
	alternate	16	18	quarterly
	quarterly	18		

Table VI-II presents a summary of the construction details of the Westpark remediation wells. The specific depths and screened intervals for the new wells will be determined from information gathered during the drilling process and are discussed in more detail in Section IV. E.

Table VI-II
Westpark Well Construction Summary

	Status	Material	Approx. Diameter	Approx. Depth	Approx. Screened Interval
WP-1	proposed	steel or PVC	8"	45'	12-40'
WP-2	proposed	steel or PVC	8"	45'	12-40'
WP-3	proposed	steel or PVC	8"	45'	12-40'
9	existing	PVC	2"	45"	20-40'
11	existing	PVC	2"	43"	23-38'
16	existing	SS	2"	17'	12-17'
18	existing	PVC	2"	32'	12-32'
19	proposed	PVC	2"	45'	12-40'
20	proposed	PVC	2"	45'	12-40'
21	proposed	PVC	2"	45'	20-40'

B. DISCUSSION OF WESTPARK PCE BACKGROUND CONCENTRATIONS

Corrective Action Wells WP-1, WP-3, 9, 16, 20 and 21 have or are expected to have PCE concentration greater than the 10 ppb clean up target. As treatment progresses, PCE concentrations in these wells should drop and the concentration should approach area background concentrations. As discussed earlier, the true Westpark upgradient PCE backgrounds concentration is uncertain. Samples to the NE and SW of the plume have yielded results below the 3 ppb laboratory detection limit (Wells 2, 3 and 14). None of these wells could be considered directly upgradient of the PCE plume although 2 and 3 are upgradient of some Westpark property.

Well #11 has yielded a concentration of 5 ppb PCE which is below the clean-up target of 10 ppb. Well #11 is the best existing well for estimating Westpark upgradient PCE concentrations. However, offsite groundwater east of Milwaukee and north of Well #11 is likely to contain PCE at concentrations greater than the 10 ppb cleanup target. This potentially contaminated body of water will require that recovery wells WP-1 and WP-2 be operated longer than if the water was not contaminated.

C. CORRECTIVE ACTION MONITORING (CAM)

1. Objective of Corrective Action Monitoring (CAM)

The corrective action monitoring program will be conducted during the two to three year period when the groundwater is being pumped and treated. The monitoring will demonstrate the effectiveness of the treatment program, assist in the proper selection of pumping rates to maintain a discharge of 10 ppb or less, and will be used to determine when the 10 ppb cleanup target is reached under the Westpark property.

2. Corrective Action Monitoring Locations and Schedule

Figure VI-1 shows the locations of the proposed Corrective Action Monitoring (CAM) wells. CAM Wells WP-1 and WP-3 are also pumping wells for water withdrawal. They will be screened from 12 feet to 40 feet. Their use as CAM wells will allow for periodic measurement of water levels for determining groundwater flow gradients and plume capture effectiveness. Well WP-3 is located in the most Northwest corner of the Westpark property. PCE sample data from WP-3 will provide water quality data as far down gradient as possible on the Westpark property. Since WP-3 and WP-1 are both pumping wells, the PCE data will provide information on concentrations in the center area of the plume and on the PCE levels being pumped through the air stripper.

CAM well #9 is also located in the center of the PCE plume. It is screened from the ≈20 to 40 foot interval. Water level measurements will assist in determining flow gradient and PCE measurements will provide data on cleanup efficiencies. Since CAM well #9 is screened in the deeper water, the PCE sampling data will assist in determining if a slug of PCE or a significant layering of PCE is occurring in the area of well #9.

CAM wells #'s 19, 20, 18, 16 and 21 are located toward the outer edge of the plume. CAM wells #16 and 21 will be sampled for PCE on alternating quarters to assist in determining if there is a layering effect of PCE in the area east of the highest known plume concentrations. Well 16 is screened in the upper water (12-18 ft.) while 21 will be screened from about 20 to 40 feet. Wells 16 and 21 are located as far east as possible on the Westpark property. PCE data will provide information on plume cleanup and potential PCE migration into the Westpark site from the SE. If sampling results indicate significant differences in PCE upper water and lower water concentrations, both wells will be sampled each quarter. Water level measurements will assist in determining flow direction and rate.

CAM well #19 will provide PCE and water level data for the area north of the plume center line. Water level information will be used to calculate flow gradient to determine plume capture efficiency. PCE data will provide information on the effectiveness of cleanup in the northern area of Parcel #1.

CAM well #20 is located to the SW of the plume. A deep well had not been constructed previously in this area. The water level and PCE data will provide information on plume capture and cleanup efficiencies. If the selected water disposal option is reinjection, Westpark will propose that CAM well #20 be dropped or that it be relocated to a more beneficial area.

CAM wells #18 and #11 are existing wells upgradient of the main PCE plume. Well #11 has previously yielded results of 5 ppb PCE. It could be considered the best current indication of upgradient PCE background concentrations from the far SE. It will be sampled for PCE to determine if upgradient concentrations change while Westpark water withdrawal is underway. If sampling data continuously yields results near 5 ppb for one year, Westpark may propose relocating or dropping well #11 from the monitoring program. If PCE concentrations significantly increase, Westpark will notify IDHW as previously discussed. CAM well #18 currently yields results near 100 ppb PCE. PCE sampling data will provide information on the efficiency of upgradient plume capture and cleanup. Well #18 will also provide information on the quality of water migrating into the Westpark area from offsite. If PCE concentrations significantly increase in Well #18 (or 11,18,16 and 21) during the treatment period, Westpark will notify IDHW immediately. Water level data from Well #18 and #11 will provide data for flow gradient calculations.

Water level data will also be collected quarterly during corrective and assessment monitoring from any of the other existing Westpark wells that are not lost to site development (i.e., 14, 15, 13, 2, 3, 4, 8, 1, 10, 5, 12 and 6). Annual reports will show groundwater flow directions using potentiometric contour maps prepared from the groundwater elevations measured in the wells. Groundwater flow directions will be shown on the contour maps as perpendicular to groundwater potentiometric contours. As discussed earlier, Westpark may petition to drop CAM wells from the sampling program or to reduce the frequency of sampling if sampling results are not yielding beneficial data.

The proposed sampling schedule is as follows, however, it should be noted that mutually agreeable changes can be made if conditions warrant. The well sampling methods used during corrective action monitoring will be the same as those used during assessment monitoring. Section VI.D.3 discusses the methods in detail.

<u>Startup to 30 Days</u>

During startup of the treatment system monitoring will include:

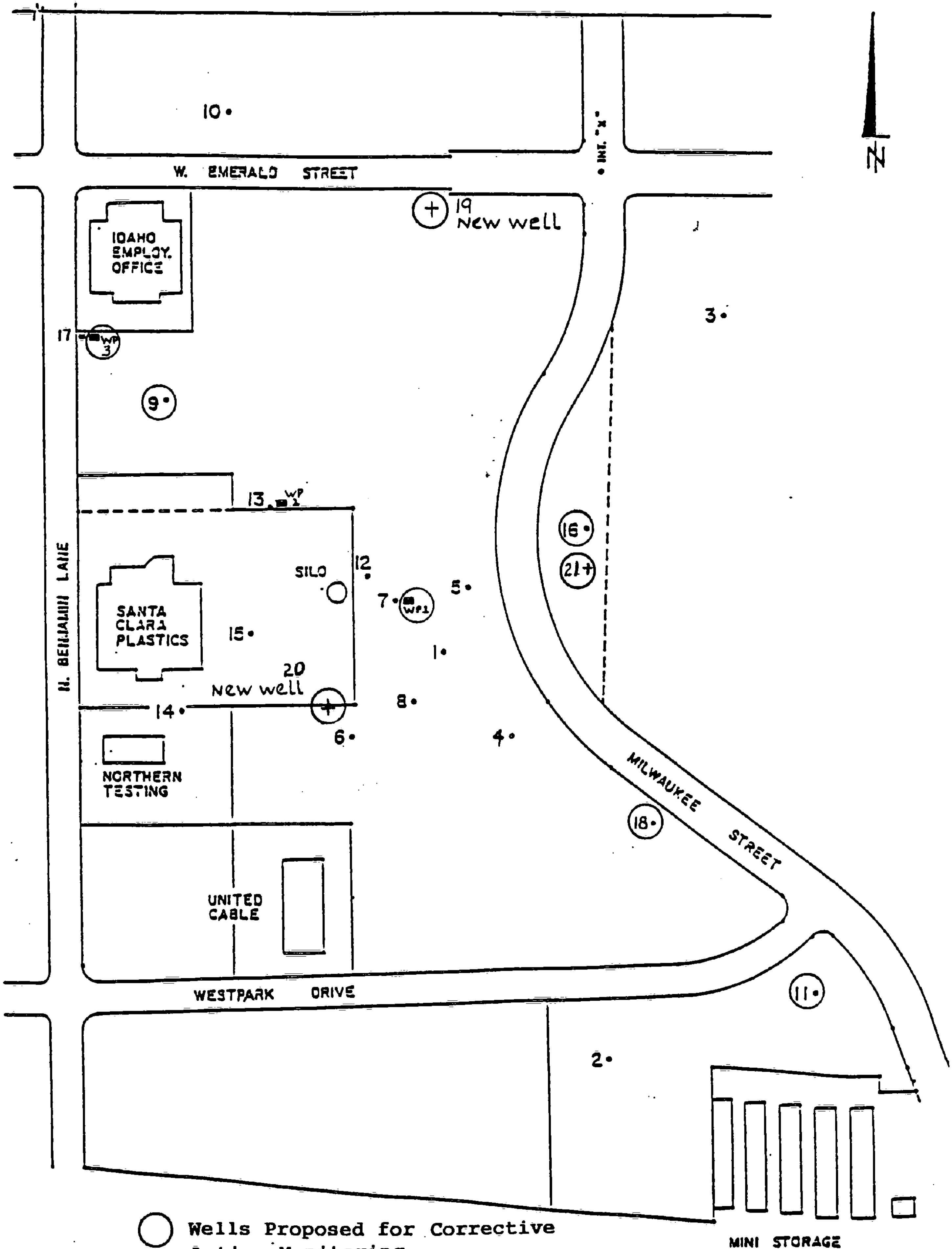
a. Weekly water level measurements to document the drawdown area of the pumping wells. If it becomes apparent after two weeks that weekly measurements are not warranted, measurements will be taken as needed to show drawdown.

b. Daily total measurement of flow through the treatment plant and flow from each operating pumping well.

c. During the first week of each pumping well's operation, 5 daily samples and analyses will be conducted on the composite influent to the system and the effluent to the disposal system for PCE and TCE. The sampling ports shown on Figure VI-1 will be utilized. Analyses will be conducted by a local laboratory using standard EPA methods. Every tenth sample will be collected in duplicate to assess laboratory precision. A qualified local laboratory is preferred for fast turnaround time.

d. After the first week of startup, weekly sampling and analysis for PCE and TCE will be performed on all active recovery wells during the first thirty days of start up of each well. Concurrent sampling will be performed on the effluent from the air stripper. If concentrations in the effluent are greater than 10 ppb the operating parameters of the system will be adjusted to achieve 10 ppb or less in the effluent. Stripper efficiency will be a mass balance measurement by calculating influent versus effluent water analysis results.

e. If during system start-up the analyses indicate that effluent concentrations are greater than 10 ppb the system pumping plan will be altered and three days of sampling and analysis will be performed to determine system performance. If quarterly sampling results indicate an effluent concentration greater than 10 ppb the effluent will be immediately resampled and



Wells Proposed for Corrective Action Monitoring

Figure VI-1 Corrective Action Monitoring Well Locations adjustments made as needed.

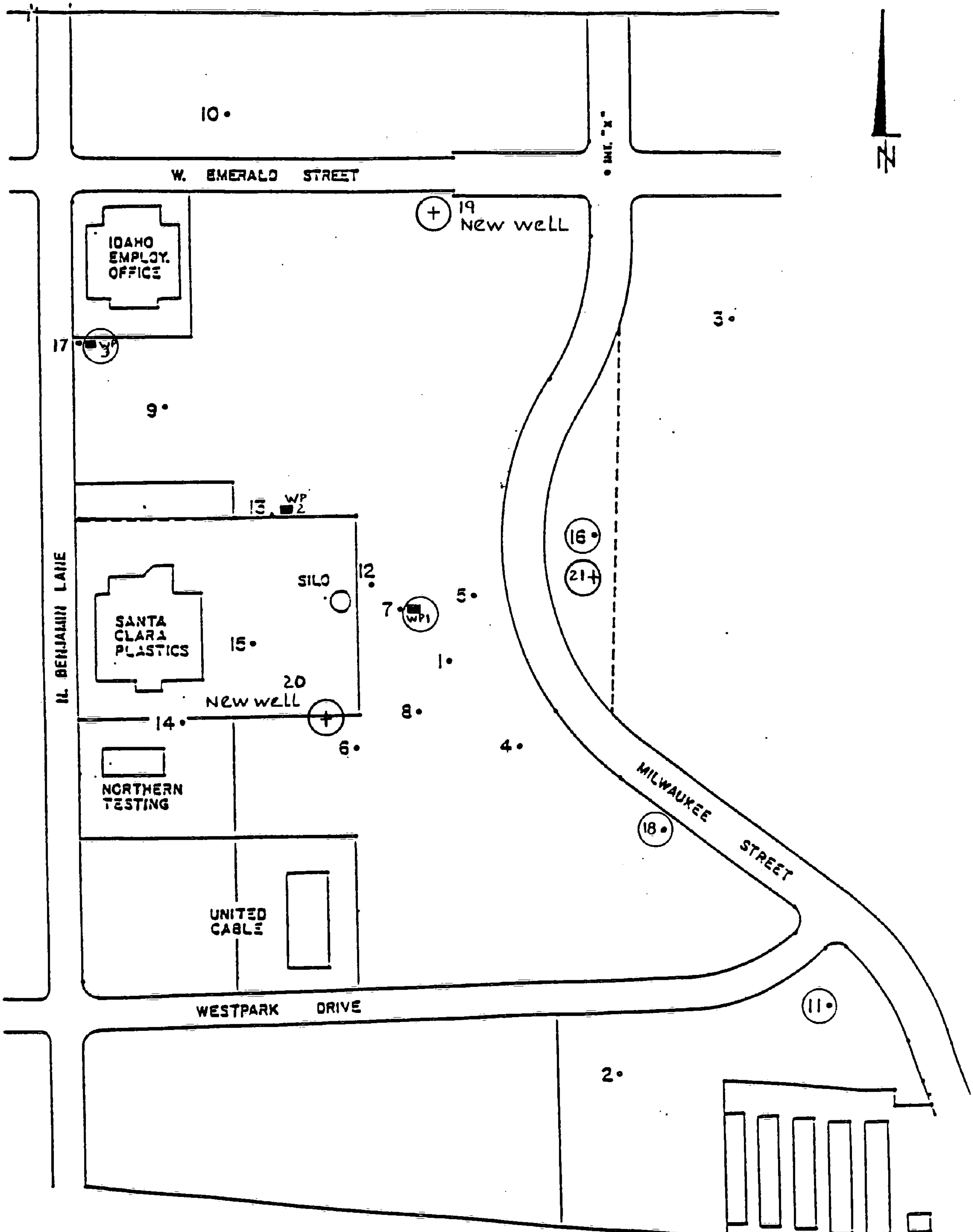
f. Westpark will operate the system according to the parameters specified in any required permits.

<u>30 days to four months</u>

a. Water level measurements will be taken on a bi-monthly basis for the second month of system operation. They will be collected monthly thereafter unless unusual drawdown conditions exist. Measurements would then be collected at the intervals needed to resolve the questionable drawdown data.

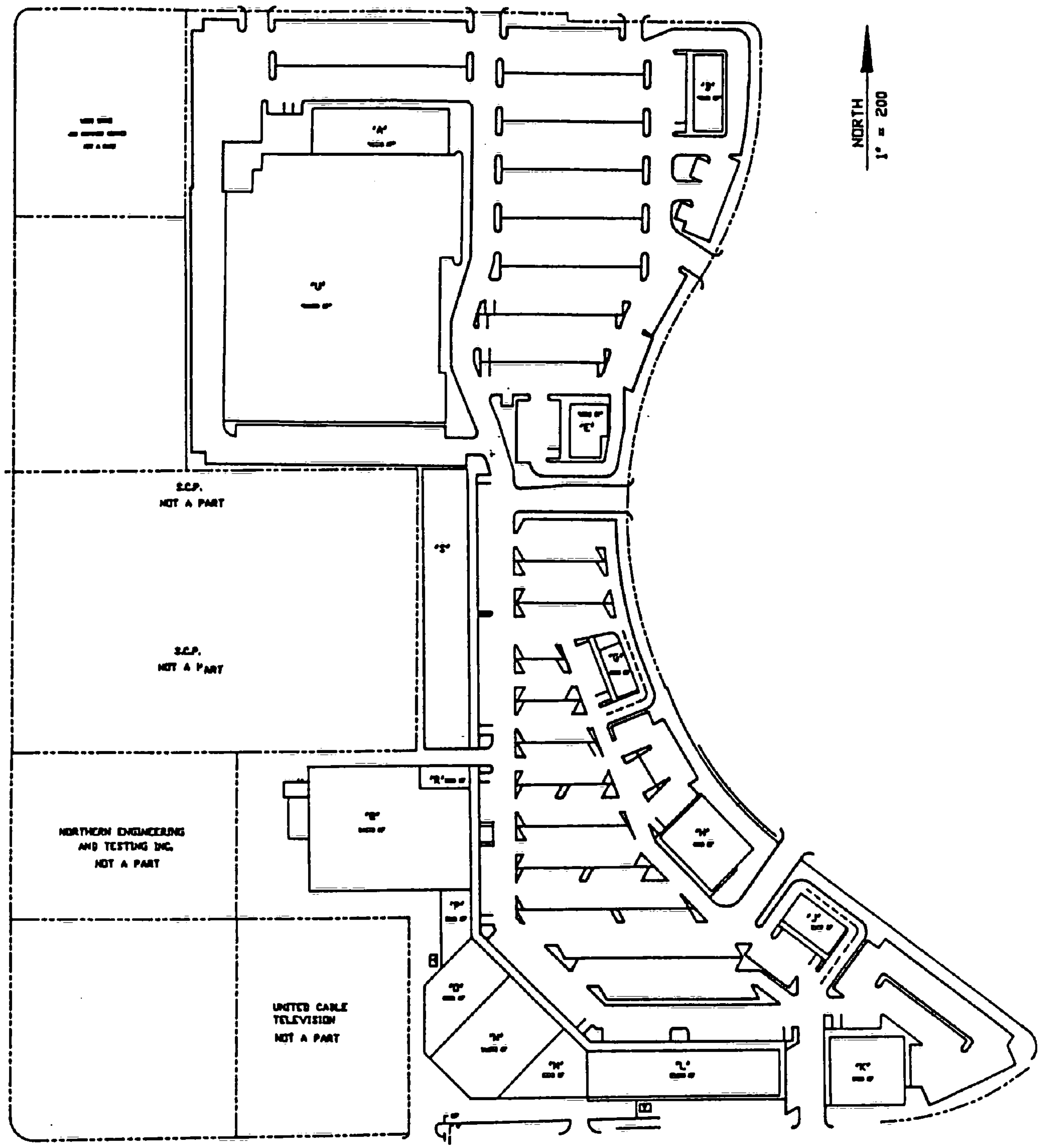
b. After one month of operation, corrective action monitoring well samples will be collected to characterize the plume. The previously discussed new wells will be installed to replace existing site wells that will have been lost to the retail development. The final locations for the new wells have not been determined because site development plans are not yet final but they will be located within 50 feet of the estimated location or Westpark will negotiate alternative locations with IDHW. Figure VI-1 shows the approximate location of the wells to be used for corrective action monitoring. Samples will be collected according to the procedures given in Appendix B and Section VI.D.3. Analysis will be performed for PCE and TCE. The CAM wells will be sampled quarterly after the first month.

c. The recovery wells WP-3 and WP-1 will be sampled in conjunction with the monitoring well sampling discussed in b. above. The sample will be drawn from sample portals installed at the well head. If the portal samples do not yield results consistent with the wells sampled by bailer, a small submersible pump (KV



Wells Proposed for Assessment Monitoring

Figure VI-2 Assessment Monitoring Well Locations



PROPOSED WESTPARK DEVELOPMENT PLAN

FIGURE VI-3

BOISE TOWNE PLAZA
BOISE, IDAHO

FORSGREN
ASSOCIATES / P.A.
210 MALLARD SUITE D
BOISE, ID. 83706

Associates centrifugal or bladder or peristolic) will be used. The composite input water and composite effluent water from the air stripper will be sampled on day 31, 60, 90 and 120 and then quarterly.

When two quarterly sampling results indicate that the groundwater has been remediated to a concentration of 10 ppb or to any higher final EPA maximum concentration limit (MCL) for PCE in drinking water (Safe Drinking Water Act MCL), the system will be shut down and placed on standby. Plume modeling indicates that the upgradient pumping wells (WP1 & WP2). could be shut down early due to lower plume concentrations in this area while the downgradient recovery well (WP-3) continues to operate. If after two years of operation the downgradient well WP-3 is not at 10 ppb or lower and does not appear to be approaching 10 ppb, an alternative concentration will be proposed to IDHW for its shutdown. The downgradient recovery well cleanup will be impacted by the unknown quantity of contamination that appears to exist west of Benjamin. Recovery well WP3 will probably require the longest period of operation.

The treatment system will be held on standby during the two year period while assessment monitoring is conducted to show that cleanup has been complete. The following table summarizes the anticipated corrective action monitoring program.

Table VI-III

Corrective Action Monitoring Schedule *

Monitoring Task	0 to 30 Days	31 to 120 Days	121 days to 2 years or longer as needed
water level	weekly	bi-weekly, then monthly	monthly or as needed
system flows	daily	weekly	weekly
composite influent	daily for 5 days then weekly	monthly	quarterly
composite effluent	daily for 5 days then weekly	monthly	quarterly
removal wells WP 1&3	weekly (WP-2 on start-up)	on day 31 then monthly	quarterly
monitoring wells	none	on day 31 then monthly	quarterly

* The monitoring schedule assumes the system is functioning properly.

3. Corrective Action Monitoring Reports

A system startup report will be submitted to IDHW after the system has operated for two months. Water level measurements, sampling and analytical procedures will be documented. Groundwater flow directions and rates will be calculated and reported. The treatment system efficiency will be reported along with estimates of the plume concentrations.

Laboratory results from the corrective action monitoring will be provided to IDHW twenty (20) days after they are received from the laboratory. An annual operating summary report will be prepared and submitted to IDHW within 30 days of receipt of the 4th quarter laboratory results. The summary report will discuss treatment system operation and clean-up progress and trend analysis.

IDHW will be notified within 24 hours or as soon as possible of an observed or anticipated system up-set. The notification will be followed in seven (7) days by a brief explanation of action taken to remedy the up-set.

When the corrective action monitoring indicates that the groundwater system has been cleaned to 10 ppb PCE, a system shut down report will be submitted to IDHW. The report will present the corrective action monitoring data to show aquifer clean-up has been completed. IDHW will review and respond to the shut down report within 30 days of receipt so that Westpark may shut the system down in a timely manner.

D. ASSESSMENT MONITORING AFTER REMEDIATION

1. Objective of Assessment Monitoring

Assessment monitoring will be conducted for two years after the corrective action monitoring demonstrates that the target concentration of 10 ppb has been achieved. The assessment monitoring will include water level measurements and chemical analysis for PCE and TCE. The primary objective of the monitoring is to confirm that the PCE and TCE have been removed from the Westpark shallow groundwater system. The water level measurements will be used for determining flow direction. The secondary objective of the PCE and TCE monitoring is to identify whether contamination from offsite is migrating into the Westpark site.

2. Assessment Monitoring Locations and Schedule

The assessment monitoring will be conducted on a quarterly basis for two years. At flow rates of 2 to 4 feet per day, the upgradient Westpark groundwater should migrate 1460 feet to 2920 feet northwest across the site. Any PCE that remains in the shallow system would be detected in two years of quarterly sampling.

The wells to be utilized for post remediation assessment are a combination of existing and new wells. Approximate assessment well locations are shown in Figure VI-2. Final locations will be dependent on retail development plans and will be located within 50 feet of locations shown on figure VI-2. If development plans require different locations, IDHW approval will be required prior to construction. The new wells will be located to minimize any impact from planned development. The development plan is shown in Figure VI-3 and can be compared to Figures VI-1 and VI-2. The primary building pad areas will not deviate significantly from those shown. Existing wells 11, 18, and 16 will be used in conjunction with the WP1 and WP3 pumping wells and the three new monitoring wells installed for corrective action monitoring (19, 20, 21). All of the assessment wells except Well 16 would be deeper than thirty feet. The screened interval on the new pumping and monitoring wells will be from approximately 12 feet to 40 feet.

The rationale for well locations is similar to that discussed in the CAM Section C. CAM well #9 is not proposed for assessment monitoring since it is between and close to WP-3 and WP-1. Assessment monitoring results for wells 16, 21, 18 and 11 will provide information on PCE concentrations migrating into the Westpark site from the SE. Water level measurements in all the wells will indicate groundwater flow direction. The PCE data will reflect the water quality in the area of the site where the well is located.

3. Well Sampling Method (Corrective Action and Assessment Monitoring)

Well 16 will be purged and sampled with a teflon bailer as described in previous project reports (i.e. three phase equipment decontamination, iced samples, one day delivery to laboratory, chain of custody, etc.). The deeper wells will be purged and sampled with 12 Volt KV Associates Model M30 submersible centrifugal pumps. Samples collected with these pumps have yielded results consistent with the bailer method. A pump will be dedicated for each of the deep 2 inch monitoring wells. The pumps will be flushed with distilled water prior to each purging and sampling. Pumping Wells 1 and 3 will be purged as slow as possible using the in place pumps (10 gpm is expected). The sample portal on the well head will be utilized if the sampling during the corrective action period shows this method yielding results consistent with the KV Associates pumps and teflon bailers.

Wells will be purged by placing the pumps within the upper five feet of static water and will then be sampled from the middle of the screened interval. Three 40 ml VOA vials will be collected from each well per sampling event. A randomly selected well will be sampled in duplicate during each quarter. A transport blank will be submitted for analysis every other sampling quarter. If analysis of the first year blanks indicate any laboratory QA/QC concerns, transport blanks will be submitted each quarter until the concern is resolved.

Prior to start up of the treatment system and monitoring well sampling, a laboratory quality control check will be conducted in conjunction with IDHW. Two Westpark well samples will be collected in duplicate (coincidental). One sample from each well will be analyzed by Westpark's selected laboratory for PCE and TCE while the duplicate samples will be analyzed by an EPA approved laboratory. Given that side by side analysis is generally considered accurate within plus or minus 30%, it is proposed that the results of the two labs be considered acceptable if they are plus or minus 25% difference.

Quarterly sample splits will be made available to IDHW one quarter during each year of sampling (at IDHW's request). One sample duplicate per year will be sent to an EPA approved laboratory for comparison if the selected Westpark lab is not an approved EPA laboratory. If concerns develop regarding data quality, a mutually acceptable program will be implemented to resolve any analysis concerns. As the sampling program progresses, a larger data base will be available for QA/QC assessment.

4. Assessment Monitoring Reports

The laboratory results for the assessment monitoring will be submitted to IDHW ten (10) days after they are received from the laboratory. An annual assessment summary report will be prepared and submitted to IDHW within 20 working days of receipt of the fourth quarter laboratory results. The summary report will discuss the results of the groundwater sampling and water level measurements and trend analyses.

Assessment monitoring is conducted after the treatment system has been shut down and the corrective action monitoring indicates cleanup to 10 ppb has been achieved.

If the results of two consecutive quarters of assessment monitoring indicate that significant PCE contamination is present, Westpark will notify IDHW and arrange for a meeting to discuss the significance of the contamination. In general, well samples consistantly exceeding the cleanup target of 10 ppb by approximately 30% will be considered significant. Westpark and IDHW will assess the location of the PCE concentrations, data trends, migration pathway, potential sources and any other pertinent factors relevent to the need for further groundwater treatment. If it is determined that further treatment or monitoring is warranted, Westpark will prepare an operation plan for IDHW review and will implement the final negotiated plan. If the need or feasibility of further treatment is questionable, Westpark will, at IDHW's request, prepare a brief assessment of further treatment feasibility.

If assessment monitoring indicates that offsite contamination is migrating into the Westpark groundwater, IDHW will be notified immediately. The treatment system will not be operated by Westpark Partnership to treat contaminated groundwater migrating into the site after corrective action monitoring shows the site groundwater has been treated to 10 ppb. Given that groundwater flows to the northwest, wells 21, 16, 18 and 11 may be key indicators of offsite contamination migrating into the Westpark site.

The statistical method for determining real changes in well PCE concentrations has not been selected. The method selected will depend on whether the data are normally distributed and how much variance results from field sampling and laboratory methods. The statistical method selected for determining real changes in contaminant levels will be applicable to the site and consistent with the methods currently being accepted by EPA. A simple arithmetic mean may or may not be appropriate for determining real changes in well PCE concentrations. If it is determined to be appropriate it will be used. Regardless of the specific procedure selected, the methodology and data will be clearly explained, example calculations shown, original data given, and literature references provided and agreed to by IDHW.

E. PROPOSED WELL CONSTRUCTION METHODS AND MATERIALS

1. Recovery Wells

Recovery well locations, W-3, W-2, W-1, are shown in Figure VI-1. The wells will be drilled with a forward rotary rig and will be cased with eight inch steel or plastic depending on the drillers ability to meet the bid specifications. Water and polymers will be used to aid drilling. A natural gravel pack will be developed by surging with air. Screen slot size will be 0.02 inch or larger. A larger slot size will require longer development but will facilitate higher flows. The anulus will be sealed from the surface to 12 feet with a cement bentonite mixture. Water and cuttings will be placed in excavated pits adjacent to the wells and allowed to seep back into the ground.

The wells will be carefully logged by a professional geologist and cuttings will be continuously assessed to determine particle size percentages (Modified Wentworth Scale), depth interval and color for each formation. H-Nu organic vapor readings will be taken and recorded with depth on the lithologic log. The wells will be screened from 12 feet to 40 feet. A five foot sump will be placed below the screened interval, therefore the borehole will be extended five feet for a total depth of 45 feet.

Additional information on the recovery wells and piping is presented in Section III. C. All construction supplies and equipment will be steam cleaned prior to well construction. Figure IV-4 shows the typical production well cross section proposed for the Westpark project. All required well permits will be obtained prior to well construction.

2. New Monitoring Wells

Three new monitoring wells will be installed at the locations shown on Figures VI-1 and VI-2: #'s 19, 20 and 21. The drilling and construction method will be as described above for the production wells. Figure VI-5 shows a typical monitoring well cross section. The approximate screened intervals and depths were given earlier in Table IV-2. All applicable permits or approvals will be obtained prior to well construction. Screen slot size will be 0.02 inch or 0.01 inch depending on assessment of cuttings. A natural gravel pack will be developed by surging with air. Bore hole logging will be conducted as discussed for the production wells above.

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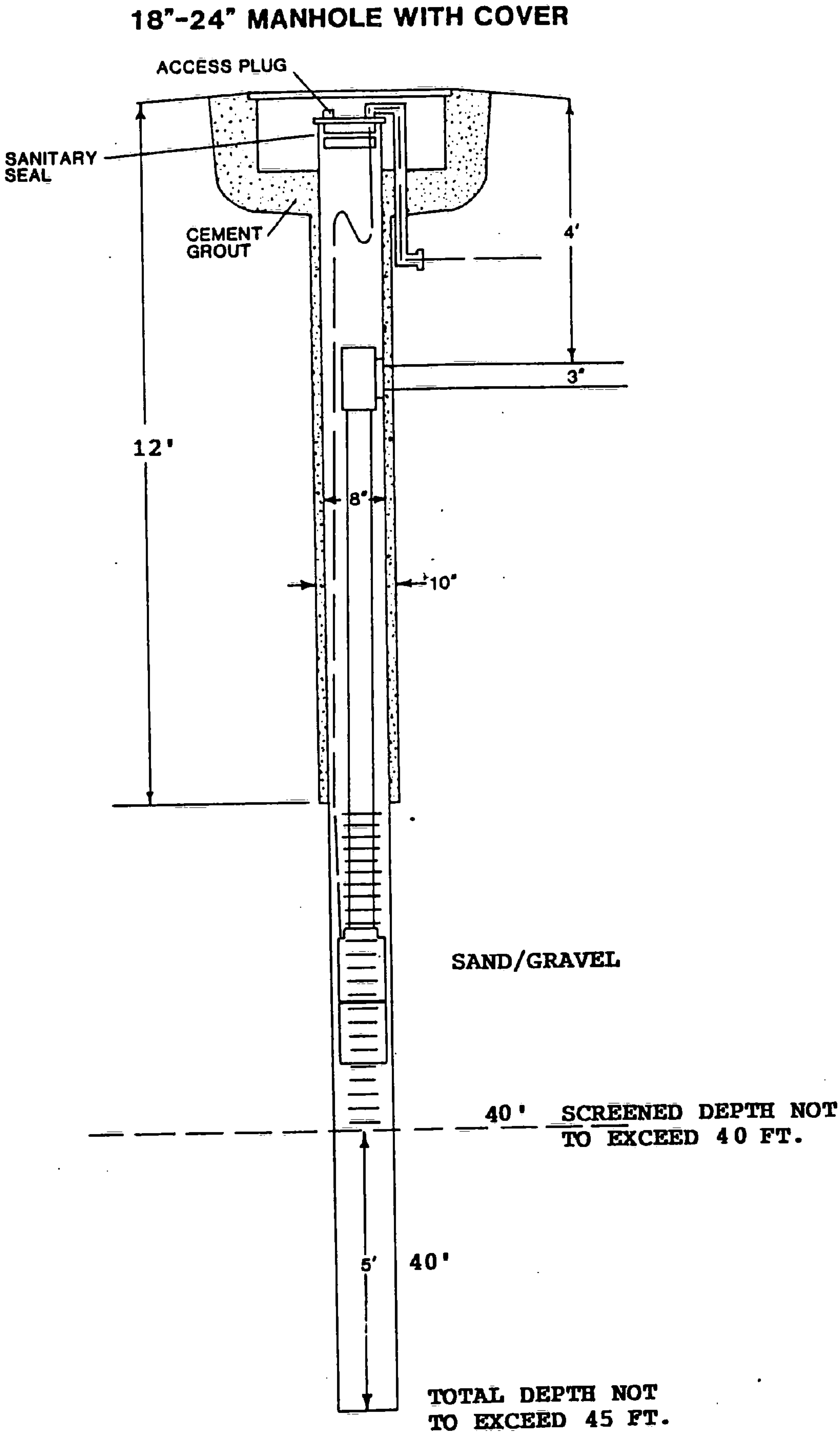
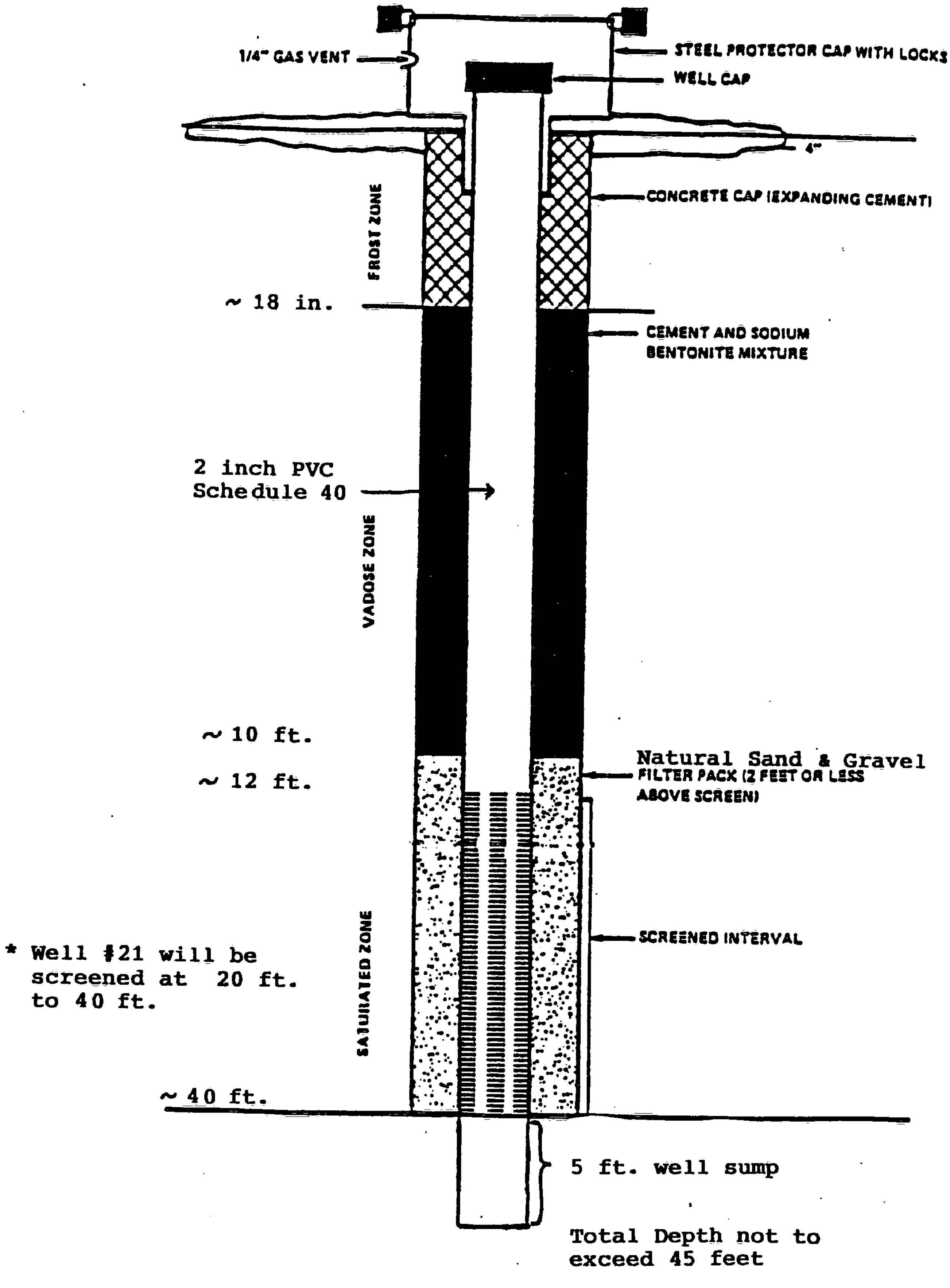
3. <u>Reinjection Wells</u>

As an alternative to sewer disposal of treated water, the effluent water may be disposed of by a groundwater reinjection technique. The proposed reinjection systems are discussed in Section V. B. The wells will be six inches in diameter and will be constructed of plastic or steel. At this time two options are being considered: 4 - forty foot wells or 8 - eighteen foot wells. A typical 18 foot injection well cross section is shown in Figure IV-6. All applicable permits or approvals will be obtained prior to well construction. IDHW will approve well locations prior to installation.



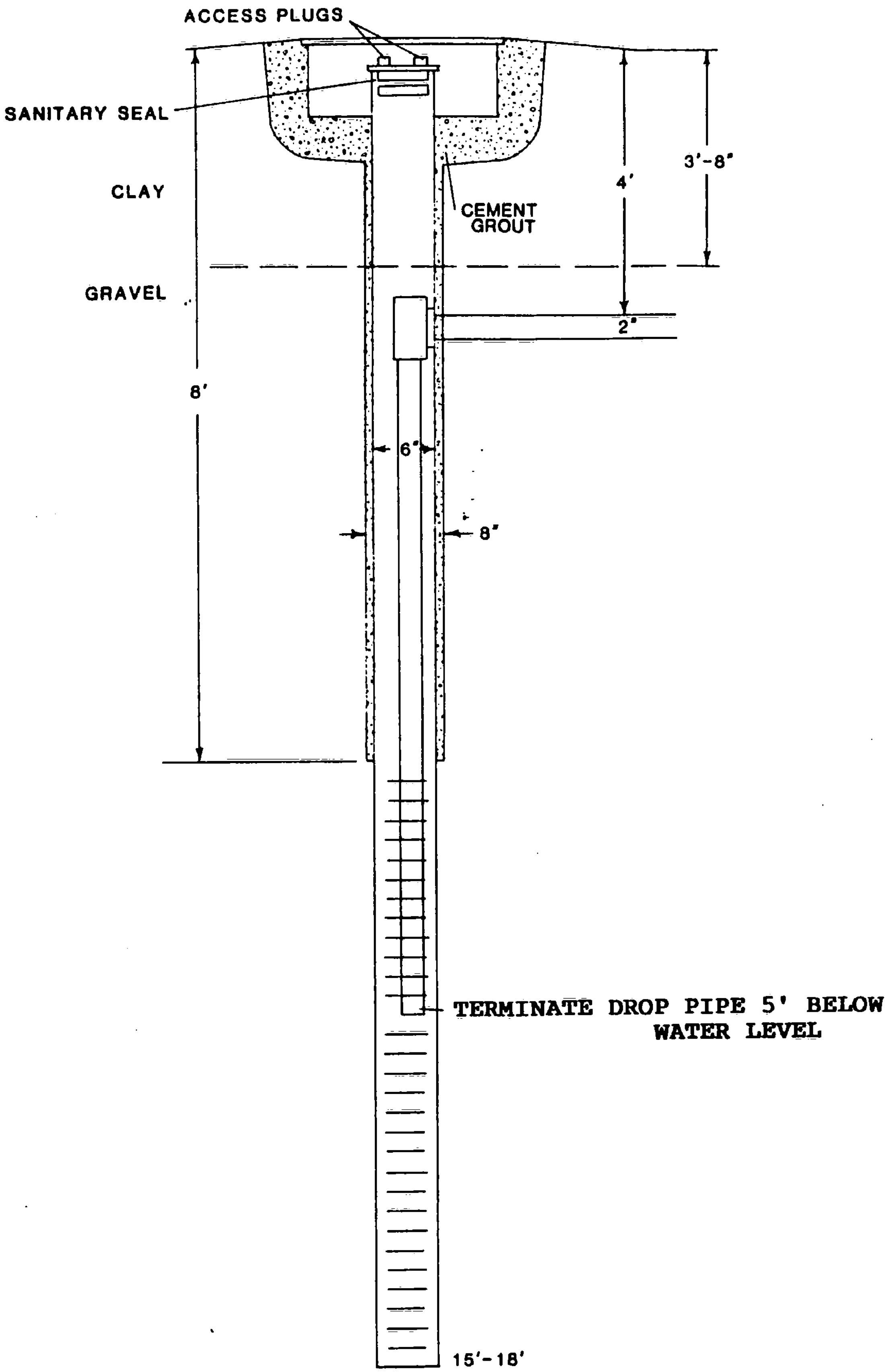
PRODUCTION WELL

FIGURE VI-4



TYPICAL MONITORING WELL CROSS SECTION

FIGURE VI-5



REINJECTION WELL
FIGURE VI-6

VII. DECOMMISSIONING OF TREATMENT PLANT AND WELLS

When the assessment monitoring has been completed and the site is determined to have met the cleanup objectives, the treatment system will be decommissioned.

A. TREATMENT PLANT

The treatment plant, consisting of the scrubber, fan, control valves, water meters, and controllers, will be decommissioned by removing and salvaging all equipment from the working slab. Due to the low levels of PCE being treated by the equipment, and the fact that the final stages of aquifer cleanup will flush all equipment with increasingly pure water, no decontamination of salvaged equipment will be required.

After removal of the treatment equipment, the security fence and the concrete working slab will also be removed. The concrete will be broken and disposed of as solid waste. The fencing will be salvaged.

Underground piping to the sewer lines will be decommissioned by excavating to the sewer connection, disconnecting and capping the pipes, and abandoning in place. The discharge at the stripper site will also be excavated to burial depth, capped, and abandoned in place. The site will then be restored to be compatible with the surrounding site use.

B. PUMPING AND MONITORING WELLS

Recovery wells will be decommissioned by removing the pump and liquid level probes, cutting off the casing below the pitless adapter (about 4 feet below grade) and filling with neat cement containing no more than 5% sodium bentonite. Monitoring wells will be decommissioned by cutting off the casing about

4 feet below grade and filling the well with neat cement containing no more than 5% sodium bentonite. Pumps will be deemed to be decontaminated by virtue of having pumped clean water during the final stages of the recovery. Piping will be abandoned in place by cutting it off below grade at the 42 to 36 inch burial depth, capping both ends and reburying them.

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